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Oil-Coal Suspensions

THE study of suspensions of solids in liquids has been distinctly advanced by the paper presented by Dr. Manning and Mr. R. A. A. Taylor to the Institution of Chemical Engineers, on February 21. The paper dealt primarily with what is known as "colloidal fuel," but the author's experimental work upon suspensions is of more general applicability. The work started as the result of a discovery made by the research department of the Cunard Steamship Co. Many people have tried during the last 20 years to suspend coal in oil so that sufficient coal could be used to cheapen the cost as compared with oil, and yet so that the mixture would be sufficiently fluid to be pumped and handled like oil. These early attempts all were based on the supposition that the coal must be ground very finely indeed and must be suspended in the oil in the form of a true colloidal solution. For this purpose most of the work hinged on the discovery of stabilisers that should be sufficient, having regard to the difficulty of comminuting the coal sufficiently, and cheap enough to be used commercially.

The Cunard Co., however, decided rightly that the coal could not be ground so finely as would be necessitated by formation of colloid particles, but that the size already in use for dust firing should be the objective. They carried this a step farther by finding that certain cracked petroleum oils would form suspensions with coal of this size without the use of a stabiliser. The size of the coal used was such that all passed through a 100-mesh I.M.M. sieve and some 80 to 90 per cent. through a 200 screen, *i.e.*, particles of 65μ downwards. If a coal of this size be suspended in an oil not possessing the particular properties demanded, the greater portion will settle quite readily.

The reason for the anomalous behaviour of the cracked oils that were found to be suitable for the formation of suspensions has been made clear by the work of Dr. Manning and Mr. Taylor. Oils that are suitable are characterised by the possession of "dilute gel structure"; that is to say, at ordinary conditions they show no gel structure, but when subjected to very low rates of shear they appear to develop a gel structure which prevents motion of the solid particles suspended therein. The viscosity of an unsuitable oil does not change appreciably as the rate of shear diminishes from a high value to a very low value. A suitable oil behaves similarly until low rates of shear, *i.e.*, low velocity gradients in the flowing liquid, are reached of the order of 20 to 30 cm./sec./cm. From this point onwards as the rate of shear or velocity gradient decreases, the viscosity rises with ever-increasing rapidity and according, apparently, to an exponential law. The liquid at rest, therefore, possesses a well-defined gel structure. The rates of settling of small particles are small, and these rates become yet smaller when many particles are present.

Clearly, the development of a gel structure at low rates of flow will be sufficient to prevent the solid particles from falling and the suspension will be stable. The fact that disturbance affects the viscosity of the oil, however, is against the use of suspensions of this type in any position where they will not be at rest. Since these oil-coal suspensions are not true colloids, when the particles happen to be deposited they do not, presumably, increase in size by aggregation, but the suspension can be reformed by stirring vigorously. This fact is of importance when the suspension may have settled out during transport, but on board ship when the mixture is in continual movement and re-formation is impossible, there seems little possibility for oil-coal mixtures of this class.

Another property of oils that are suitable for forming non-stabilised suspensions with larger solid particles is that when the dilute gel structure is destroyed by vigorously agitating the oil, it will develop again slowly if the oil is left at rest, so that the oil again resists small distorting forces applied under constant conditions. This property may be tested by allowing the shaken mixture to stand in a U-tube in which it is displaced by application of a pressure. It is then allowed to flow back through part of the displaced distance and the time taken is measured. If the treatment by displacement and flowing back is continued at intervals it is found that a suitable oil completely recovers its dilute gel structure within some 50 hours or less, at 25° C., whilst an unsuitable oil shows no increase in the time taken to flow back. The matter is important because the general types of flow viscometers operate with a low rate of shear and may condemn an oil or a suspension for pumping when it is really quite satisfactory in practice because it only develops high viscosity when under low rates of shear. It is sometimes found that by stirring a more viscous oil vigorouly and putting it several times through the viscometer its measured viscosity falls to the same value of that of a quite satisfactory oil of known low viscosity. Clearly the indications of viscometers must be regarded with more circumspection than previously. The authors must be congratulated on having brought forward a simple method of observing the settling of suspensions.

Notes and Comments

New Industry for Lancashire

A MAGNESIUM metal and alloy factory, capable of supplying the total requirements of the whole of the British aircraft, motor, and other magnesium-using industries, is to be established at Clifton, Lancashire, by Magnesium Elektron, Ltd., associated with F. A. Hughes and Co., Ltd., of London. This is not only a new industry for Lancashire, but a new source of employment for British labour, as at present most supplies of magnesium and its alloys are being obtained from foreign sources. Sir Humphrey Davy first isolated magnesium in 1808, but a hundred years passed before the problems of production were satisfactorily solved. The special fabricating technique has now been mastered in this country, and the fact that magnesium is 40 per cent. lighter than aluminium and can be supplied at an economic price enables it to be utilised to meet the ever-persistent demand for lighter construction in aeroplanes, vehicles, and in a variety of machinery. The shipbuilding industry is also interested in magnesium because of its phenomenally low specific gravity. Permanent employment in Lancashire will be given to at least 150 miners to produce the additional coal necessary to generate the required electricity in the Kearsley power station of the Lancashire Power Co. for this purpose. Many other workers will find employment either within the Clifton works of Magnesium Elektron, Ltd., or in the production and installation of the new plant, or in producing coal, coke, and other manufacturing materials

Manchester Chemical Trade

IF British chemical exports are an index to the general prosperity within the industry, 1935 was satisfactory in several directions, says the annual report of the Chemical and Allied Trades Section of the Manchester Chamber of Commerce. Unfortunately the continued unsettled state of international trade had its effect on several other branches of British industry, with the result that the home demand for certain types of chemicals was somewhat retarded. As chemicals are essentially connected with the major industries it is inevitable that adverse influences affecting such other trades react upon the chemical industry. In connection with the Chamber's trade mission to Australia, led by Sir Ernest Thompson, many members of the Chamber interested in the chemical and allied trades discussed their particular problems in that market with Mr. H. C. N. Ellis, the Chamber's special commissioner and manager of the department for the promotion of export trade, who is accompanying Sir Ernest Thompson. The outcome of the discussion was a decision that the export chemical trade presented no serious difficulty as far as Australia was concerned and that the services of the mission could be utilised more advantageously in other trades. The section is paying attention to the problems that will arise on the expiration of the Safeguarding of Industries Act next August. If there is a general consensus of opinion among members as to the course that would best serve the interests of the trades represented, suitable representations could be made to the appropriate authorities. It is up to the members to make their desires known in good time.

Chemists and Unemployment Insurance

THE British Association of Chemists is in the unique position among professional societies of having an existing scheme of unemployment insurance which has been successfully operated for thirteen years, and in view of the proposal which has been before the Government for some time that unemployment insurance should be extended beyond the present £250 per annum limit its officials were recently called upon to give evidence before the committee presided over by Sir William Beveridge. The Association has found from its experience in working the fund that a member who loses a high-salaried appointment often has great difficulty in securing another and that in many instances chemists in responsible positions who in normal periods expect complete security of tenure have in fact in recent years found themselves out of employment. In the opinion of the Association there is no logical reason for fixing any particular limit of salary for the purpose of insurance. Moreover, the Association feels that having regard to the proved low incidence of unemployment among chemists, the profession should have liberty within the Insurance Act to continue and extend its own scheme. The matter is, of course, only in its preliminary stages, but important developments in the near future are possible.

Institution of Petroleum Technologists

THE Institution of Petroleum Technologists is to be congratulated on the addition of another member to its family of local sections. The new branch, known as the Northern Branch, which was inaugurated at Manchester on February 28 by Sir John Cadman, G.C.M.G., president of the Institution, is unique in that its membership is being drawn chiefly from those engaged in the distribution and utilisation of oil, whereas the members of all the other branches, situated in Burma, Iran, Roumania, South Wales, and Trinidad, are concerned primarily with production or refining. London apart, Manchester is the foremost port in the kingdom for the import of oil, which is conveyed direct from the oil-producing countries to the tankage installations along the banks of the Ship Canal; and in view of the large personnel, technical and commercial, engaged in handling the oil a more suitable centre for the Northern Branch could not have been selected. At the same time, the area represented by the branch is so extensive that the committee, in arranging its programme, might consider the possibility of holding occasional meetings outside Manchester. Such an arrangement would not only ensure the continued support of the branch by its members in other parts of Lancashire, in Yorkshire, and elsewhere in the North, but would also be the means of increasing the membership. The branch was particularly fortunate in obtaining Sir John Cadman to give the inaugural lecture on "The Applications of Science to the Petroleum Industry," in the course of which he referred to the attempts that were still being made to find whether petroleum actually existed in this country. The importance of the discovery of local supplies of good-quality oil cannot be overestimated.

Is Commercialism a Menace to Industry?

Professor J. F. Thorpe's Address to the Institute of Chemistry

Professor Jocelyn F. Thorpe, C.B.E., F.R.S., President of the Institute of Chemistry 1933-1936.

ON his retirement from the presidency of the Institute of Chemistry at the annual meeting on Monday, Professor J. F. Thorpe addressed the members on the question, "Is Commercialism a Menace to Industry?" Whereas commercialism as a basic principle is a most desirable and, indeed, necessary method of progress towards national prosperity, he said, yet if applied without due thought or discretion it is apt to be a direct menace to industrial research, and therefore to industry as a whole. When commercialism and industrialism clash, industrialism retires defeated, but when they are not antagonistic they are mutually self-helpful and dependent.

The vast improvement in our industrial conditions which followed the war placed commercialism in its proper place, namely, in one of subservience rather than of dominance. The internal manufacture of essential materials was provided for and the necessary research work required to keep the economic balance and ensure the personnel necessary for progress in new discovery and in the new applications of old discoveries was present in an ever-flowing stream from the research schools of our universities to the research laboratories of the factories. Industry learnt to realise that there was no essential difference between the trained research worker and the supervisor in charge of works processes, and that a sound training in fundamental science was essential to both types.

One of the Causes of Our Troubles

A menace with which commercialism threatened industry was the purchase abroad not only of finished materials but also of processes. This kind of menace was in operation before the war, and it was one of the causes of our troubles that many firms had purchased—mainly from Germany—a man with a process who was installed in this country and given every facility to carry out his work. This form of menace was of a peculiarly subtle type, because it did not, at first sight, seem reasonable to suggest that the purchasing and operating in this country of new methods discovered abroad was bad for industry. Neither was it, provided the inevitable repercussion on our research organisations was mitigated and controlled by the complete transference of the method to this country so that it could be operated by our own people and improved by investigations carried out in our industrial research laboratories. But the greatest care must be taken to see that this method was applied only in the most special cases, otherwise the effect on our research organisations would ultimately lead to their extinction, and once extinguished they could never be revived. Sometimes, in the pre-war days, when a new process was introduced, when customers were accumulating and good business doing, the chemist who had been imported to control affairs would return to his own country, with full knowledge of the concern which he had been serving, and would operate for the benefit of a firm abroad, and cut out the business which he had helped to build up here.

It was only when the commercial instinct took charge and the desire to purchase from abroad became predominant that the true nature of the menace became apparent. The purchase of both materials and processes from outside meant that so much less chance was afforded our research schools to foster national industry and so much less chance was given them of placing their men in suitable employment. Unless industry supported its own research laboratories and through them the research training schools the latter could no longer exist. It was useless for industry to provide funds for the provision of research schools unless it could provide employment for those who passed through them.

America was probably hit just as seriously as we were by the withholding of essential supplies, which she could not provide for herself, during the war, but the tremendous internal resources of that great country prevented the same crisis arising, or, at any rate, rendered it less acute than here. The progress made in the application of research to the industries of both this country and the States had been nothing short of marvellous. The old empirical methods which lost us the dyestuffs industry—for the Perkin discovery was left to commercial men to develop—were no longer possible. The conditions which were mainly the cause of the depression in the cotton industry—namely, the reliance for too long on old discoveries—were not now likely to recur.

The American method of scrapping out-of-date machinery and replacing it by new and improved appliances was rapidly finding favour in this country where, for too long, the bogey of amortisation had held sway. If progress was to continue, the same must be true of knowledge, for we must scrap the old ideas and give the new ones a chance, seeing to it that the genius of our own people was given full scope for development, and that it was not smothered by the blanket of commercial indifference. Those who were getting on in years could look back over a period of change and development such as no human being in any other generation could have surveyed.

The Next Fifty Years

What the next fifty years was likely to bring forth was a matter of surmise. It was difficult to imagine that progress would be as rapid or as novel as during the past half-century, although it was certain that we were on the eve of great advances in connection with various branches of science—organic chemistry in its relations to biology and medicine being one of the many in which far-reaching discoveries were likely to be made. But, whatever the nature of these discoveries, whatever their value to human nature might be, it was certain that the nation that made them and could utilise them industrially would be the one which would become predominant intellectually, mentally and financially. Let us therefore see to it that we possessed a strong and ever reinforced army of research workers, and that we equipped ourselves to occupy the place proper to our race and people.

If ever there were a country in need of industrial research and the provision of new knowledge and methods, surely it was ours. The coal age which gave such a tremendous im-

petus to our industries was passing, and already the oil age had taken strong hold. Too late we were devising all manner of schemes for utilising of coal supplies for purposes applicable to modern conditions. New methods of utilisation had to meet the competition of oil, and started severely handicapped in the race for economic existence. Nevertheless there had been a great and steadily-expanding advance in the attitude of industrialism towards industrial research—an advance which had to a large extent been due to the far-sighted policy of Imperial Chemical Industries. This organisation had succeeded in bringing into line the main chemical research organisations to such a degree that it could no longer be said that the major portion of the potential power for investigation in this country was wasted. Those great sources of new knowledge and new methods, namely, our university laboratories, were being more and more utilised in the service of industry, and already there had been no small measure of reward. The clear vision which had produced this advance had seen beyond the immediate needs of industry, and had realised that a system of industry based on rule-of-thumb was but a house built on sand.

Oil was now available in such enormous quantities and so easily obtainable that restriction, in the interests of commercialism, had to be placed on its production. Moreover, the combine of interests eliminated to a marked degree the occurrence of competition. In general, the engineering problems associated with production were of the simplest kind, and the methods of fractionation adopted left little to the skill of the chemist. The processes were wasteful and uneconomic to a degree, but since the provision of the final product was all that was required no one seemed to mind so long as dividends were maintained. As a matter of fact, petroleum could be made the source of a vast number of chemical products of service to man, and the fact that such products were lost was not due to bad business but to lack of enterprise. How long the nations would allow their natural resources to be frittered away was determined only by the time it took those in authority to realise what was happening. Otherwise it would last until there ceased to be commercial profit in the undertaking, and by that time the oil position would be far worse than that of coal at the present time.

It was an amazing fact that so few scientific people were on the board of directors of companies dealing with industries based on scientific methods. Only the other day someone speaking after dinner to an audience of chemists said that no scientist should be on a board of directors because he would wreck the business within a week, the speaker's contention being that a scientific director would always be striving after something new, and would consequently scrap the older methods. His argument was evidently the old one, namely, that the best is the enemy of the good; but what a specious argument.

There were definite indications that we were slipping back into the old bad way and that commercialism was gradually exerting its baneful influence on the research organisations. It was so easy for a commercial nation to lull itself into a false sense of security and well-being because the commercial method was so much simpler and more reliable—for a time—as an aid to financial profit than the path of the industrialist; yet it was a truism to say that unless one supported the other both must perish. We required a better understanding of research by the commercial people and a knowledge of its importance both to them and to the nation as a whole. If this could be acquired all would be well.

Dr. R. H. Pickard Inducted as President

DR. R. H. PICKARD, director of the Cotton Research Association, president of the newly-formed Joint Chemical Council, and past-president of the Society of Chemical Industry, was elected president in succession to Professor Thorpe and was formally inducted into the chair. The council and officers for the ensuing year were elected.

Professor THORPE, in moving the adoption of the annual report, recalled that the Institute celebrated its Charter Jubilee last July, when it received congratulations from His late Majesty King George and from many societies and institutions. The present report, he said, recorded a year of marked progress. The work of the nominations, examinations and institutions committee had been especially heavy; the number of candidates for examination had increased, and there are 90 candidates for the examinations to be held in April. The publications committee, under the guidance of Mr. W. J. A. Butterfield, had improved the "Journal and Proceedings," and some excellent lectures had been published during the year as separate monographs. Professor Thorpe congratulated the sections on their remarkable activity, and thanked their officers and committees for the services which they rendered to their respective sections and to the profession.

Dr. R. H. Pickard, who was elected President of the Institute of Chemistry on Monday.

The thanks of the Institute were also due to all who had contributed to the programmes of the sections. The roll of membership had made good progress during his term of office, as shown by the following figures from the annual reports:

	Fellows.	*Associates.*	*Total.*
Jan. 1933	1986	4068	6054
,, 1934	1993	4149	6142
,, 1935	2006	4279	6285
,, 1936	2051	4462	6513

—an increase of 459 members, compared with an increase of 340 in the previous triennial period. The gross increase of members in the same period was 880, and the gross losses 421, including 144 from death and 277 from resignation and other causes.

The number of entries for the examinations had also increased. 407 candidates had been examined, of whom 212 were successful, compared with 338, of whom 199 passed, in the previous triennial period. These figures, however, did not include a large number of *oral* examinations, conducted regularly by interviewing committees at headquarters and at other centres. Financially, the Institute was holding its own. The statement of assets and liabilities at the end of the year 1935 showed an excess of assets of £30,782 compared with £24,595 at the end of 1933—an accretion of £6,217, which included £600 received in legacies.

Colloidal Fuel

A Lively Discussion at the Institution of Chemical Engineers

MR. A. B. MANNING and Mr. R. A. Acton Taylor, both of the Fuel Research Station, were the joint authors of a paper on "Colloidal Fuel," which was read at a meeting of the Institution of Chemical Engineers on February 21. Dr. H. Levinstein, president of the Institution, presided.

Apart from the purely technical advantages of coal-oil mixtures over other fuels, said the authors, there is the economic consideration, important for this country, that their use would tend to diminish the imports of oil and find an outlet for a corresponding quantity of coal, with attendant advantages to the coal and other industries. For the mercantile marine and fishing fleets alone, excluding the coastal trade, 353,000,000 gal. of fuel oil were taken into the bunkers of British vessels at British ports during 1934; this is twice the amount for 1932; and if it had all been replaced by a coal-oil mixture similar to the one quoted, a market for nearly 750,000 tons of coal from our own mines would have been created, while about 500,000 tons less of oil would have been imported.

A Misnomer

The name colloidal fuel is commonly used for coal-oil suspensions, but is really a misnomer. The upper limit of size for particles of colloidal dimensions is about 0.1μ and, although attempts have been made to form truly colloidal suspensions of coal in oil, great, if not insurmountable, difficulties, both technical and economical, appear, however, in their practical realisation. Normally the size of the particles of coal in a coal-oil fuel ranges from 1 or 2μ to 65μ or more.

Among the earliest organisations to treat colloidal fuels as a problem of major importance was the "Submarine Defense Association," a body formed in 1917 by a group of American shipping, insurance and oil companies, when, during the war, the conservation of fuel oil required urgent consideration. Under the chairmanship of Lindon W. Bates this organisation initiated work that led to the production of a stable coal-oil fuel, and trials were carried out, under service conditions, in the U.S. Scout "Gem" between April and July, 1917. Large-scale work on this fuel seems to have ceased after the war, but the method of stabilising the mixtures, kept secret during hostilities, was disclosed in a series of patents which Bates obtained later (Brit. Pat. 149,306; 153,591; 154,538; 154,605; 155,209; 159,173; 160,754; 161,929; 165,418-23; 165,415).

Cunard Investigations

Interest was greatly stimulated in colloidal fuels, especially for marine purposes, by the voyage of the Cunarder s.s. "Scythia," which made the round trip between Liverpool and New York during the period ending in the first week in July, 1932. In this trial one boiler out of twelve normally fired with oil was fired with colloidal fuel. The fuel was the result of investigations carried out in the Cunard Steamship Co.'s laboratory, followed by large-scale tests which confirmed the findings of the laboratory. The mixture contained 40 per cent. of powdered coal ground to pass a 200-mesh I.M.M. sieve; a more concentrated suspension gave a fuel too viscous for convenience. In 1932 tests were also carried out in Germany with a fuel "Fliesskohle" consisting of a mixture of 55 per cent. of powdered coal and 45 per cent. of tar oil, prepared by the Maschinenbau A.-G. Balcke.

Stephen L. Wyndham, of Wyndham's Liquid Coal Co., Ltd., of Cardiff, has more recently developed a process (Brit. Pat. 410,833) for preparing colloidal fuel by grinding a mixture of oil with the previously coarsely ground coal in a series of specially designed mills. The most suitable proportions of coal and oil are said to be one to one, and the fuel is reputed to be stable for a minimum period of four months at ordinary temperatures. The fuel used in the demonstration was made of 50 per cent. of washed duff of calorific value 14,360 B.Th.U. per lb. supplied by the Ocean Coal Co., and 50 per cent. of an Anglo-Iranian fuel oil having a calorific value of 19,375 B.Th.U. per lb.

Stability of Coal-Oil Suspensions

A suspension of pulverised coal in oil will, in general, be unstable, and there will be a progressive deposition of the coal at a rate dependent on (*a*) the size of the coal particles, (*b*) the viscosity of the oil, (*c*) the concentration of the suspension, and (*d*) the specific gravities of the components. The suspension must possess a certain degree of stability before it can conform with the requirements of a fuel of this type; thus, for marine purposes no noticeable settlement should occur on storage at atmospheric temperatures during a period of approximately six months, or at higher temperatures of 50° to 100° C. during periods between a few days and a few hours.

The methods for conferring this stability on the mixture fall under four main headings: (*a*) Reducing mechanically the particle size of the coal; (*b*) conferring a gel structure on the oil by incorporating in it a suitable agent—a "fixateur" or stabiliser; (*c*) using a peptising agent; and (*d*) choosing an oil of a type which gives stable suspensions without the need of adding a stabiliser or of other special treatment. Little doubt is left by exhaustive tests on coal and oil recovered from stable suspensions that such stability as may be achieved with mineral oils is mechanical. No discernible change in either the physical or the chemical properties of the coal or the oil recovered is found, and, most significantly, even the particle size distribution of the recovered coal is found to be inappreciably affected, indicating that each individual particle of coal is recovered unchanged, although it has been incorporated in the suspension, an effect which could not be attained if peptisation or solution of the coal occurred in a stable mixture.

Plauson, one of the pioneers on this subject, suggested in 1913 and again in 1920 that the coal should be ground to colloidal dimensions. He ground mixtures of coal and oil in a colloid mill, driven at a high speed, sometimes adding a protective colloid such a soap, gelatin, casein or rubber. The process was costly and does not seem to have had any industrial application, although he claimed that such a fuel prepared from a coal containing not more than 1 per cent. of ash would be suitable for use in engines of the Diesel type.

Peptisation of Coal

Certain oils, in particular high-boiling tar oils, have the property of dispersing bituminous coals more or less completely when the powdered coal and oil are heated together, the coal passing into colloidal solution in the oil; this process is known as "peptisation" of the coal. The addition of tar oils to suspensions of finely divided coal in petroleum sometimes has the effect of stabilising the mixture. This effect is probably due to peptisation, and, when it is achieved, some type of structure is conferred on the oil phase, possibly the structure of a dilute gel, so that the oil is enabled to support the remaining unpeptised coal. Petroleum oils alone do not seem to exhibit this effect to any notable extent; heating coal in petroleum oils to the temperature at which incipient decomposition of the coal takes place has, however, been proposed, although it is stipulated that the material should go through a colloid mill afterwards.

Particular interest attaches to the Cunard Steamship Co.'s discovery that some fuel oils, especially certain oils produced in cracking processes, form stable suspensions of pulverised coal of the size described as economic in its cost of production,

without the necessity of using a stabiliser or of treating the coal in any other preparative way; confirmation of this is not lacking. The Cunard patent implies that there is a correlation between the carbon residue of an oil and its capability of giving stable suspensions of pulverised coal.

The oils which are suitable do not always appear to possess a gel structure, at least they do not exhibit a measurable rigidity towards distorting forces of small magnitude nor do they peptise the coal; they do, however, show a type of structure resembling that of a gel by displaying anomalous viscous properties; they possess a coefficient of viscosity which increases as the rate of shear, or velocity gradient in the flowing liquid, decreases.

To determine in the laboratory the stability of colloidal fuels, there must be a simple method for following the extent of settlement in a suspension, and a simple test by which to judge the suitability of an oil for making such suspensions is also necessary.

Combustion of Colloidal Fuels

The results of the full-scale tests which have been carried out with colloidal fuels show that these fuels can be burned quite satisfactorily in suitable types of equipment, but the provision of special appliances is no doubt advantageous. Observations on the flame produced by this type of fuel indicate that the two constituents burn more or less independently, the oil first and then the coal. It is necessary, therefore, as with pulverised fuel firing, to provide sufficient space for the complete combustion of the slower burning solid particles before the flame impinges on the boiler tubes, or at least to see that by suitably arranging the air supply they are given an opportunity to burn early in their passage through the combustion space, otherwise the boiler tubes will become covered with a deposit of incompletely burned material. Moreover, again as with pulverised fuel firing, it is desirable that combustion should be so controlled that slagging of the ash is avoided; provision must, of course, be made for the removal of any ash deposited. Combustion is improved if a small amount, say 3 per cent., of water is added to the fuel, preferably just before it reaches the burner.

No modification was found to be necessary to the oil fuel equipment already installed, but in the preparation of the fuel for the test on the s.s. "Scythia" the coal was ground to pass completely through a 200-mesh I.M.M. screen, a degree of fineness rather greater than was necessary to ensure stability of the fuel; this was done to reduce as far as was convenient the possibility of choking in the jets of the burners. It is likely that with specially designed jets a somewhat coarser coal could be burned.

The use of colloidal fuels, said the authors in conclusion, has not become general, but is likely to be fully and seriously considered with the advent of higher fuel oil prices. There is no reason to believe that colloidal fuel cannot be made to perform satisfactorily as a fuel, even with little or no adjustment to the means at present available for handling liquid fuel. For purposes for which a fuel without ash is required, however, colloidal fuel will be unsuitable, unless some modification of working conditions can be achieved. The phenomena on which the achievement of stability in colloidal fuels depends are now well understood.

Points from the Discussion

Dr. R. LESSING said it was necessary to discriminate between purely physical suspensions of coal in oil where nothing else happened and where the mixtures were merely subject to questions of the viscosity of the oil and rate of shear to which the system was subjected, and cases in which there was a deeper interaction of a chemical nature between the oil and the coal. For the purpose of preparing a stable mixture, said Dr. Lessing—laying stress on the need for stability at any rate for a period of several months during which the mixture should not settle to any large degree—it was necessary to have a high viscosity of the oil apart from very fine grinding of the coal and a low rate of shear. In practice the mixture itself should have, of course, a low viscosity—whatever " viscosity " in that sense might mean—and it certainly was used, in pumping, under high rates of shear. In other words, people with less respect for language than he had would say that good "pumpability" must be obtained, and that was where the question of thixotropy came in as applied to these mixtures. There might be a mixture of fairly high solid concentration which appeared to the eye and to the general test as being rather too viscous or too thick to pump, but when the mixture was subjected to pumping and to high rates of shear it became easier and yielded to the force applied. It was there that salvation lay because whatever was done to the oil in suspending coal in it, it was inevitable that it would be made thicker.

Determination of Viscosity

On the question of determining the viscosity of mixtures, in some work which he did a year or two ago for a large shipping company, Dr. Lessing used for the measurement of the viscosity of the mixture itself the double cylinder method in which one cylinder was suspended on a wire of definite tensile strength, whilst the other cylinder was rotated at a definite speed, the oil being in between the two cylinders, and by rotating the outer cylinder the drag on the inner one—the torque produced on the inner cylinder—was measured by the deflection of a pointer on a mirror. It seemed to him that that method might fill the need mentioned by Mr. Taylor for obtaining a measure of viscosity which was more likely to be useful for practical use than any method of flow through an orifice, such as the Redwood or the Ostwald methods.

Mr. G. H. ABBOTT said a good deal had been said about the different types of oil used in the manufacture of colloidal fuel, but it would also be interesting to know if different types of coal had been used and whether any partially carbonised coals had been used in the making of these suspensions. To say that the answer to the reason for the stability of these mixtures was anomalous viscosity, did not seem to him to be the fundamental answer because it was only one property. Was it not possible that surface tension played some part in it? Those who learned about colloids at college had to do a great deal of surface tension investigation, and it might be that in measuring the viscosity of these suspensions by ordinary U-tube methods or any other flow methods the actual surface of the containing vessel played some part. Whether it was moist, in the case of water suspensions, or whether it was dry, seemed to alter the rate of flow and perhaps this was also extended into the body of the suspension. If the measurements were carried out in a different type of vessel made of a different material, would that affect the viscosity?

An Extreme Case of Thixotropy

Professor H. E. WATSON said the authors had dealt mainly with an extreme case of thixotropy, but it might be possible perhaps to demonstrate the point not by using two colloidal bodies but by using the same oils and putting in, for example, barium sulphate or other finely divided crystalline bodies of an entirely different nature from coal and in that way obtain information on the purely thixotropic side, *i.e.*, where an oil was effectively a solid under a very low rate of shear. In that way it might be possible to sort out the complexity. Then there were substances which were ordinarily regarded as a colloid in which surface adsorption played a very large part, and he imagined it would be quite possible to obtain coals and oils which were not thixotropic by themselves but which still gave stable suspensions.

Mr. S. HUNN, referring to the fact that the authors found one fuel oil satisfactory and another not so satisfactory, suggested that this might easily be explained by the fact that the oils came from different crudes and had different pour tests with different quantities of wax. It was a well-known fact in connection with pour tests that when an oil was warmed up for a certain time the wax took days to evolve and that accounted for the viscosity increasing with time.

Mr. P. C. POPE, referring to the question of a name for these suspensions, suggested that "oil-coal" was a perfectly clear title and would not lead to the misunderstanding arising from such a term as "coal-oil." Referring to stability, he said that in such work as he had done he had found that after stirring the mixture there was a much greater rapidity of settlement if the mixture was stirred several times after it had been made. For instance, if the mixture was stirred and left for a short time, and this process was repeated several times, the rapidity of settlement increased with the number of stirrings. His work had only been done in narrow vessels, about four inches, and whether that would still be true in the case of larger vessels in which the mixture had been standing for a very much longer period with a small rate of settlement, he could not say.

Mechanical Stability

Mr. J. L. STREVENS (in a written communication) said there was no doubt that any stability achieved in mixtures made exclusively with mineral oil was mechanical and even when the temperatures were raised to the point of incipient decomposition of the coal, the same held true. It was quite another story when coals were suspended in coal-oil or in mixtures of mineral oils with coal-oil, as experiments he had carried out showed conclusively pronounced peptising and solution effects on prolonged storage at atmospheric temperature which were greatly accelerated at temperatures up to 300° C. Care was necessary, however, when preparing mixtures containing both coal oils and petroleum oils, to choose ingredients which had no sludging tendencies, otherwise instability would take place with the sludging. Referring to colloidal fuels prepared from typical Iranian and American fuel oils of medium viscosity, he said the most satisfactory stabiliser was rubber. This, in the form of low-grade crepe preferably aged and milled into the oil prior to mixing with the coal, need only be used in very small proportions to give a suitably strong, low shearing gel structure to any mineral oil product, but it was not so suitable with coal oils.

Referring to the coal side of the subject, Mr. Strevens said his own company—the National Coke and Oil Co.—made approximately 1,000 tons weekly of colloidal fuel mixture (50 coal : 50 oil) for processing, but the principles involved in its manufacture were the same as if it were intended for direct fuel purposes. The coals used were both non-caking and caking bituminous and lignitous types from a variety of coal fields. The oil was practically standard, consisting of coal-oil from the process plus a make-up of light creosote oil. According to the coals in process, the mixtures varied considerably in their viscosity and pumpability, but they were all of about the same stability. Both moisture and ash also played their parts in the kind of mixture produced. As was the general case when considering coal treatment, those coals of the highest purity and lowest ash and moisture content yielded the best colloidal fuels.

Utilisation of Standard Equipment

As to the burning of colloidal fuel, there had been insufficient large-scale work to do other than generalise on its suitability as an oil substitute. Very little was known about maintenance of equipment or the snags that developed after long usage. It was known, however, that the two constituents burned independently. Standard equipment, therefore, must be adapted to suit the requirements of the new fuel, but such adaptation was not very drastic. In view of the fact that 40 :60 and 50 :50 mixtures were harder to market and possessed features objectionable to the normal oil user, it was suggested that future work might better be concentrated on mixtures containing a minimum of 30 per cent. coal. There was a most pronounced difference between a 30 :70 and a 50 :50 or even a 40 :60 mixture, especially in pumpability, burning and viscosity.

Mr. A. E. WALTERS said the pumping of colloidal fuels had received his attention for some considerable time, and after various trials with different types of pumps he now confined his work entirely to the double-acting reciprocating type with ball valves. It had been found that cylinder wear and scoring was by no means as bad as might be expected, although no doubt this was kept down by good pulverising and mixing together with the fact that the coals used had a reasonably low ash and were free from hard siliceous lumps. Pump maintenance was not excessive, and examination of once per fortnight being found quite ample, this usually being to examine valves and cylinder by removing the cylinder cover to inspect for deposits which were usually found to be negligible. The amount pumped was of the order of 10,000 gal. per day per pump. The fuel was heated up to 50° C. prior to the pump suction and was 100° C. on the pump delivery side.

Dr. Manning Replies

Dr. A. B. MANNING, replying to the discussion, said there was a difficulty in determining the viscosity and what was required was a viscometer which would give a range to include the anomalous viscosity which had been referred to. A rotating cylinder viscometer was under construction at the Fuel Research Station. He agreed with Mr. Abbott as to the difficulty of measuring viscosity without moving the system. The authors had only investigated a very limited number of oils and did not like to generalise because no doubt different oils behaved in different ways. Moreover, the subject had not been investigated by the authors to the degree of accuracy he would like, but they were having a new viscometer made which it was hoped would throw fresh light on the subject.

As regards types of coal, there again the authors had been working in a somewhat limited field with bituminous coals, and from a small amount of work with the anthracites there seemed to be greater difficulty in getting stability with them due to the difference in density. He agreed that "anomalous viscosity" was not a complete answer to the problem and the ultimate cause of stability in these suspensions would have to be traced farther back. At the same time, he felt that the anomalous viscosity was the answer from the practical point of view, because it gave something which could be measured in the laboratory and enabled it to be said which oils satisfied the test and would make suitable suspensions.

The interesting point as to the relationship between the oiliness of lubricating oils and the behaviour of suspensions was one which the authors had considered to a certain extent, and they were grateful to Mr. Abbott for further evidence of such a relationship. He agreed that the study of other finely divided bodies in the oil might throw light on the problem, but the authors had not considered it seriously. He would have liked to put a single particle of coal in the oil and watch what happened to it on standing, but that was impossible because the oils were so extraordinarily opaque. As to thixotropy, he had always fought shy of the word, but it was a fact that some of these oils showed thixotropic properties by which was meant that an oil, if allowed to stand, set to a gel. If it was then stirred vigorously or subjected to any mechanical kind of treatment it turned back to oil.

A PROPOSAL authorising the Icelandic Government to erect a calcium nitrate plant at a reported cost of Kr. 1,500,000 has been presented to the legislative assembly. It was stated that an engineering firm with affiliations in both the Netherlands and the United States had worked out the plans. The maximum annual output of the projected plant was reported to be 35,000 bags of calcium nitrate and 15,000 bags of compound fertiliser, containing nitrogen phosphoric acid and potash. The cost of production per bag for calcium nitrate was figured at Kr. 15.30 as compared with Kr. 22.70, the current market quotation for the imported product, most of which comes from Germany. For the NPK compound, the estimated production cost per bag is Kr. 25.24 as compared with a market price of Kr. 34.00 for the imported German product. The plant can be completed in the course of 14 to 16 months.

Applications of Metal in Chemical Engineering

By H. W. CREMER, M.Sc., F.I.C., M.I.Chem.E.

Extracts from an Address delivered before the London Section of the Institute of Metals on February 6.

Mr. H. W. Cremer, Hon. Secretary of the Institution of Chemical Engineers

ONE of the most serious difficulties which besets the path of the chemical engineer is in the choice of materials of construction, and this in spite of the greatly increased range of materials now available for his purpose.

Undoubtedly, great progress is being made in the discovery of new materials, and improvements made in the quality of well-established products, for usually the introduction of a new material is quickly followed by an improvement in the quality of the older, from which healthy competition the chemical engineer derives considerable benefit. Nevertheless, such are the vast developments in the chemical and allied industries in recent years, many of which impose highly severe conditions of service on the plant employed, that the manufacturer who considers that present-day constructional materials and methods of producing them are likely to satisfy requirements for some time to come is likely to be speedily disillusioned. For instance, who would have thought possible twenty-five years ago the amazing developments which have taken place during recent years in the use of large-scale high-pressure equipment, employing conditions of a then quite exceptional kind, and necessitating the use of constructional materials with very special properties?

Demands of Modern Industry

Quite apart, however, from the special conditions referred to, there are still many corrosion and allied problems which continually confront the chemical engineer in his more commonplace work. This is more or less generally realised as regards the heavy and fine chemical industries, but, in addition, modern industry as a whole demands an increasingly wide range of chemical substances for everyday use, which can be suitably transported and stored, and which, in the food and textile industries, for example, must be kept scrupulously free from contamination by impurities dissolved from containing vessels.

There are not only the physiological effects of metallic impurities to be considered, but the appearance of products may be affected in various ways. The discoloration of varnishes due to traces of copper, and tin haze in beer are cases in point. It is also necessary to exercise care regarding the impurities present in the substances handled. Aluminium will, as is generally known, resist the action of strong nitric acid and nitrous fumes, and in works in which nitric acid is manufactured from the atmosphere or by oxidation of ammonia gas aluminium is undoubtedly a great success as a constructional material. On the other hand, when nitric acid is manufactured from nitrate of soda, which almost invariably contains a little chloride, aluminium fans would probably last only a few hours, for the gases passing through the recovery towers would not be simply a mixture of nitrous gases and air, but would also contain chlorine compounds. Similarly, in the manufacture of sauces, ordinary vinegar has little action on aluminium, but the addition of a little common salt causes attack to develop.

Need for Large Scale Experiment

It must be borne in mind, too, that it is not always a question of plant corrosion or of contamination of product, but that chemical effects are sometimes brought about by the materials of which the plant is constructed, when constructional materials act as catalytic agents or, in other cases, actually alter the course of a chemical reaction. Thus, in the chlorination of benzene to chlorbenzene it is advantageous to use an iron vessel, since this material acts as a catalytic agent in accelerating the reaction. On the other hand, if it is desired to manufacture benzyl and benzal chlorides from toluene, one must be careful to avoid even the possibility of a trace of iron getting into the apparatus. In some hydrolyses of nitro-chlor aromatic compounds either iron vessels or copper vessels can be used, but it is found that the reaction proceeds far more quickly and smoothly in a copper vessel, and this is presumably a catalytic effect. A knowledge of such properties is obviously of primary importance in selecting constructional materials, and can only be acquired by experience on a large scale, since laboratory experiments are of little value in such cases.

A recent and particularly interesting case may be quoted where the metal of the reaction vessel brought about abnormal results which led to an important new discovery, *i.e.*, the phthalocyanines, the formation of which was originally observed as a blue impurity in phthalimide prepared in iron vessels. This product is now on the market as a very stable pigment.

Increasingly Exacting Requirements

Now, although the chemical engineer is not slow in acknowledging the debt which he owes to the metallurgist in supplying him with many of his constructional materials, neither is he slow in proclaiming that his present requirements are still far from being satisfactorily met. He is mindful also that these requirements are likely to become more exacting as time goes on. This is clearly evident by the fact that, in spite of their less desirable mechanical properties in many respects, he frequently has recourse to *non*-metallic materials of construction, either alone or as linings to steel or wooden vessels. Those interested in the production of metals and alloys may rest assured, however, that the chemical engineer, generally speaking, prefers a constructional material which possesses the characteristic qualities of a metal as regards strength, ductility, durability (including, of course, resistance to corrosion) and ease of fabrication, if he can be assured of accessibility of supplies of uniform quality and suitable cost. Chemical engineering processes, it may be added, are carried out industrially for economic reasons, the object being to make a profit; this fact appears to be sometimes overlooked by those who seek to provide the chemical engineer with his materials of construction.

Conditions in Practice

The chemical engineer requires materials to meet conditions which involve corrosion, erosion and severe conditions of temperature and pressure; frequently a combination of two or more of these. Each of these conditions may be considered briefly although since these are so closely interrelated it is quite impossible to avoid overlapping.

Obviously, in corrosion as in the other cases referred to, the selection of material is all-important. Some observations on the value of laboratory tests on samples, however, are called for in this connection. Such tests are of undoubted value as a method of elimination and narrowing down the choice of materials. They may be most misleading, how-

ever, when the final choice has to be made. For the actual processing of a metal or alloy (*e.g.*, casting, shaping, welding, riveting, caulking, etc.) may affect its corrosion-resisting properties to such an extent that failure occurs when it is brought into service. It is important, therefore, to ensure that the material is tested out in the condition in which it will eventually be used, *i.e.*, in the form of a casting, forging, tube, plate, etc., and, better still, before using it in actual manufacturing plant, to test under manufacturing conditions an item of fabricated plant. It is no less important that corrosion tests should always be correlated with visual examination, microscopic examination and mechanical tests after exposure, since the determination of loss of weight alone is of very limited value, and although this is no doubt well realised by many persons it certainly appears to be overlooked by others.

Texture and Chemical Resistance

It is well known that the resistance which a material of construction can present to chemical attack depends upon (1) the chemical composition, (2) the distribution of the chemical components into distinct constituents or "phases," and (3) the arrangement of those constituents in space, *viz.*, what may be regarded as the "texture," which has so profound an effect on chemical attack. The bearing of texture on chemical resistance formed the subject of a lecture delivered by Dr. C. H. Desch before the Institution of Chemical Engineers rather more than a year ago,* in which reference was made to a variety of metallic and non-metallic materials. Papers of this type are of the utmost value to many users of metals to whom a metal is still just a metal, good, bad or indifferent, useful or non-useful in a given set of conditions, and to whom the physical characteristics of such a material under various conditions of treatment are very incompletely known. Fortunately, such persons are becoming rarer nowadays, and certainly the modern chemical engineer fully realises the need for a sound knowledge of metallurgy.

To quote examples given by Dr. Desch, the chemical behaviour of grey cast iron, a material widely used for chemical plant, depends very largely on its texture. This metal is essentially a conglomerate, in which plates of graphite, a soft and mechanically weak substance, but highly resistant to chemical influences, are embodied in crystals of soft iron or ferrite in which iron carbide and iron phosphide are dispersed in various ways, in quantities depending on the composition. Leaving out of account the special acid-resisting cast irons, which are mainly alloys of iron and silicon, and also those highly alloyed chromium and nickel irons which have inherent corrosion-resisting properties, the resistance of cast irons to chemical action, including that of air and other gases at high temperatures, is mainly a function of the size and distribution of the flakes of graphite.

Again, grey cast iron used at high temperatures as for fire bars is liable to become greatly distorted through increase in size. This "growth" of cast iron, which is due largely to oxidation, increases with the size of the graphite plates. Large plates provide easy channels for the passage of oxidising gases and produce the maximum thermal effects, so that a close grained grey iron is much less susceptible to growth than one of more open structure. The control of grain size of the graphite has been closely studied and methods devised for treating the iron before casting so as to ensure that the graphite shall be precipitated in fine flakes, free from tendency to form a communicating network.

Questions of Purity

Questions of purity, including freedom from non-metallic matter, are frequently of great importance, as recent work on aluminium of a high degree of purity has shown, and the question of varying distribution of impurities is also of considerable consequence, the presence of sulphur segregates in cast iron, for example, resulting in preferential attack in such zones. As a general rule, the presence of almost any electrolyte will encourage pitting, since an E.M.F. will be set up between the metal or alloy and the non-metallic particle; the non-metallic particle is usually anodic and the pit forms at this point.

In addition to pitting and general solution of constructional materials, probably one of the most prolific sources of trouble arises from contact between dissimilar metals. A good example may be found in evaporator practice where copper tubes have been expanded into mild steel tube plates, resulting in a ring of pitting or grooving in the tube plate. A somewhat similar set of conditions is presented when a part of the metal is deformed. Local cold-working, as in the metal immediately surrounding a punched rivet hole, or where local injury has been caused by hammering or marking with a letter punch, is a fruitful cause of corrosion. The cold-worked metal contains more potential energy than that which is unstrained, becomes anodic, and a local couple is set up. Thus an iron rod which has been twisted or hammered is more rapidly dissolved by acids than a similar rod in the unstrained state.

Effect of Polishing

A rough surface is acted on more easily than one which is smooth, and the rate of attack increases as the radius of curvature of the ridges and grooves becomes smaller. Again, the vitreous structure of a polished surface, which has had its crystalline arrangement broken down by the severe deformation of polishing, contains more potential energy than the unstrained crystal, but the increased chemical activity may be masked by the increased smoothness. From the practical point of view, however, the effect of polishing in smoothing the surface and obliterating fine cracks is of greater importance than the increase of potential energy, which theoretically involves a greater tendency to be attacked by chemical solvents.

A crack, if sufficiently fine, will not allow entrance of a substance capable of bringing about attack, except to the extent of a thin adsorbed layer. In such conditions there will be no further chemical action so long as the metal is at rest. If subjected, however, to alternating stresses the crack will open when the surface in which it occurs is in tension, and in the compression phase of the cycle a very high local pressure will occur in the crack. Under such conditions it appears extremely likely that the effect of the substance which enters (oxygen from the atmosphere, an electrolyte from a surrounding solution, or a corrosive gas) would be greatly enhanced, and that chemical attack which might not otherwise occur might set up. Such an effect would account for corrosion-fatigue, for it is well known that the normal fatigue resistance of a metal under alternating stress is greatly lowered when the cycles of stress are applied in the presence of a corrosive medium.

The Range of Stress

In presence of corroding media, even for steels with a high resistance to corrosion, there is perhaps no limiting range of stress which the material will withstand for an indefinite time, and, given sufficient time, alternations of even a very small stress will bring about destruction. This effect is quite independent of any weakening of the metal by ordinary corrosion, such as pitting, it being only found when the cycles of stress are applied in actual presence of the corroding medium. It is characteristic, moreover, of fatigue cracks that they are never inter-crystalline, at any rate in normal metals, and this peculiarity is also particularly noticeable under conditions of corrosion fatigue. In fact, the cracks appear to take pains to avoid the crystal boundaries.

Since most metals are covered, after exposure to air, by an extremely thin film of oxide or hydroxide, which if of the right texture serves as a protection against further chemical action, it is frequently considered that the effect of alternating stress is to rupture this film and thereby to expose the unprotected metal to the corrosive agent. Whilst this

* Texture and Chemical Resistance. "Trans. Inst. Chem. Eng.," 1934, *12*, 198.

is to be expected with a film thick enough to be brittle and to fracture in tension, it appears far less likely in a film of molecular thickness, bound to the metallic surface by chemical forces. Such a film might be expected to adhere perfectly until the elastic limit of the metal had been so far exceeded that an ultra-microscopic crack could open, thus allowing of the intensified activity already referred to. In such a case one is dealing with disconuities of little more than atomic dimensions, and there seems to be ample scope for experiments on the protective effect of films of different thicknesses under conditions of alternating stress.

Before leaving this general subject of corrosion, passing reference should be made to some special cases of intergranular attack, in which the chemical agent which will bring about cracking is one which penetrates along the grain boundaries, failure being due to the separation which occurs between the crystal grains. The season-cracking of brass is only one of a number of forms of damage to severely deformed metals which are familiar in industry. Other typical examples are provided by the commonly termed "weld decay" in austenitic stainless steels, by caustic brittlement, and by hydrogen attack. In stainless steels containing, for instance, 18 per cent. chromium and 8 per cent. nickel there is always some carbon present which, initially in solid solution, is precipitated on prolonged heating getween 550° and 650° C. The carbide is precipitated at the grain boundaries, which then becomes very susceptible to attack.

Inter-Granular Weakness

The carbide precipitated is one very rich in chromium, so that in the course of its formation it withdraws chromium from the surrounding alloy, the diffusion of more chromium to take its place being very slow compared with the migration of carbon. The result is that in the neighbourhood of the boundary the alloy is depleted of chromium, and if the amount should fall below 12 per cent. the property of chemical resistance is lost. The boundary thus becomes chemically weak and open to attack by reagents. Probably the first instances of such weakness were observed in welded plant, in which a region on each side of the weld and at a small distance from it had been heated in the dangerous zone of temperature, and rapid corrosion by nitric acid and other chemicals was found to occur. Since steels of this class are so largely used for chemical plant and accessories it is highly important to avoid this inter-granular weakness. The effect can be prevented by the addition of certain stabilisers, titanium being one of the most frequently used. This forms a stable carbide which on precipitation does not deplete the alloy of chromium. Tungsten, molybdenum and certain other elements are also used and the mechanism of stabilisation is probably not the same in all cases.

Caustic Embrittlement

The second example, caustic brittlement, is sometimes observed in high-pressure steam boilers. The necessary conditions appear to be the presence of a high internal stress, coupled with the possibility of caustic alkali reaching a certain concentration in contact with the stressed metal. The cracking brought about in this way is intercrystalline and is quite different from ordinary corrosion, such as is produced by acid waters to counteract which the alkali has been added. Nitrates have this same property of penetrating between the crystal grains of steel, and both calcium and ammonium nitrate will sometimes bring about the rapid destruction of a steel vessel, even when the surface in contact with the solution is only in slight tension. Cold-drawn steel tubing has been destroyed in the same way by molten nitre.

The question of hydrogen attack is one of extreme importance, since so many modern syntheses depend upon the use of hydrogen as one of the reactants. The action at high temperatures alone may not be very serious, but when high temperature is combined with high stress, as is so frequently the case, the effect is very marked. Mild steel, for example, undergoes serious attack, the latter again being intergranular in character. Decarburisation occurs, and pearlite areas may be completely removed in some cases.

Erosion is frequently the result of previous corrosion which has roughened the surface, thus allowing erosion to take place. The answer is not always to be found in the employment of very hard surfaces or hard metals, and a radical change to a soft resilient surface such as rubber has frequently remedied chronic cases of erosion. Manganese steel has been used successfully for dredger buckets where abrasive sand or gravel is being excavated; also for pump impellers for dealing with magma containing grit, sand, etc. This variety of steel, as is well known, in the course of use with such materials increases in efficiency due to work hardening. Another example is the deposition of stellite on surfaces by welding as in the case of mechanical parts used for conveyors handling very abrasive substances. Nevertheless, frequently in practice it is found when pumping abrasive magma that a change to a softer, more corrosion-resisting alloy cures the trouble, *e.g.*, a change from cast iron to Ni-resist.

(To be continued.)

Silicate-Filled Soaps

Present-Day Use in Germany

In a paper read before the German Chemical Society ("Z. angew. Chem.," February 1), Dr. Lottermoser refers to the stringent restrictions on the use of oils and fats in Germany for industrial purposes, especially soap-making, with the consequent need for the selection of suitable fillers to add to the fat charge. These limitations do not yet apply to toilet soaps, though an early extension thereof to include these is anticipated; for other classes of soap they are sufficiently drastic. In ordinary grain or curd soap the allowed maximum is 50 per cent. as compared with 63 per cent. previously, and in other kinds of soap, such as oxygen-washing preparations, soap powders and flakes, very considerable reductions in the fatty acid content have been imposed. It is considered that the fatty acid content has been reduced to the lowest tolerable limit, and in some cases possibly lower.

In the choice of suitable fillers the following are the principal conditions to be observed: (a) Their presence in the soap must not be easily detected by the user, (b) they must not prove injurious in any way to the articles washed, (c) they must not materially affect the economical use of the soap. Sodium silicate probably meets these conditions better than most fillers. Dr. Lottermoser makes a few practical suggestions as to the best methods of manufacture for silicate-filled soaps, such as the partial saponification of the fat charge only in one pan and then transfer to a second pan where the silicate solution is added together with more soda and potash to complete saponification. The incorporation of the right amount of potash is of considerable importance for stability and water-holding power.

In considering the effect of silicate-filled soaps on articles in the wash, the nature of the deposits which may be formed in the fabric is discussed at some length, and various differences in these deposits, according as they are formed from the use of filled soaps or genuine soaps, are noted. It is understood that water of some degree of hardness has been used, for with soft water there would appear to be little or no risk of such deposit. If genuine soaps are used with hard water, lime salts, as is well known, are formed and are practically insoluble. A considerable deposit of these salts may be formed among the fibres of the fabric, imparting to it a greasy feel and frequently also an unpleasant smell, but not necessarily weakening the fabric. With silicate soaps the deposits are of a somewhat different kind. They may be very hygroscopic, swell easily, and, on drying, break down into dust. The objection sometimes alleged that they are frequently of a hard sharp-pointed crystalline nature, causing serious injury to the fabric, is disputed by Dr. Lottermoser, although, in the case of all such deposits, he alludes to the possible injury that may be caused to the human skin.

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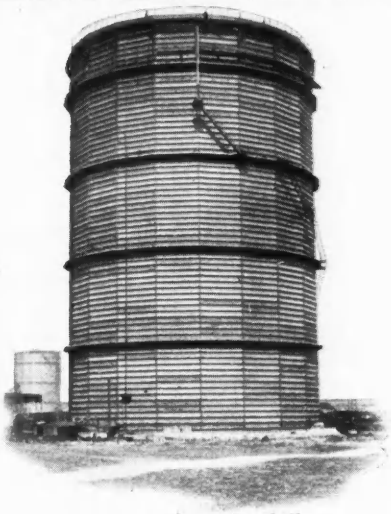

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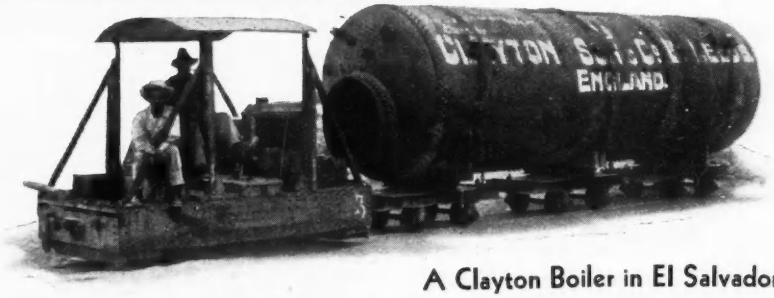

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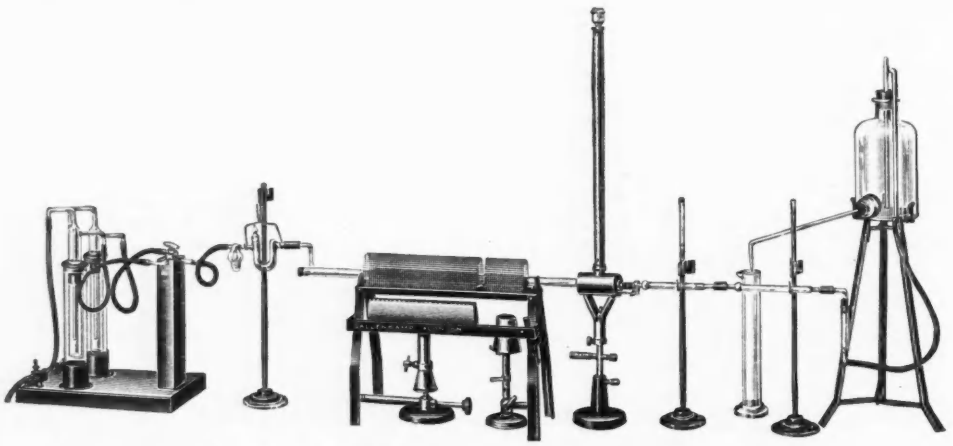
Microanalytical Methods

An Excellent Training for the Young Chemist

MICROANALYSIS is a branch of the art in which minute attention to detail is absolutely essential. Indeed it is probably not too much to say that for the successful application of quantitative microanalytical methods it is highly desirable, if not absolutely essential, for the manipulator to receive a training in a laboratory where microanalytical methods have already been established. For although it is true that most quantitative micromethods are reduced macroprocedures, it is not feasible as a rule to carry out a microanalysis only on the basis of experience gained in macroanalysis. The ultimate reason for this, said Mr. Norman Strafford, M.Sc., F.I.C., of Imperial Chemical Industries, Ltd., in a paper read before the Chemical Section of the Manchester Literary and Philosophical Society on February 28, is that as the scale of operation is reduced, the errors of the determination are not necessarily reduced in the same proportion, unless particular precautions are exercised.

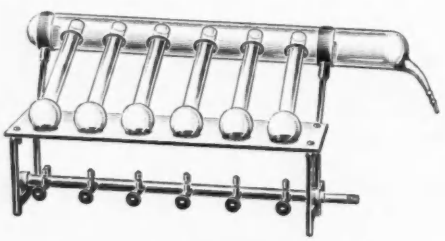
Mr. Strafford added that he did not wish to create the impression that there is anything fundamentally difficult about microanalysis. It is only a matter of acquiring, once and for all, a special but quite simple technique; once this is mastered it is quite safe to say that no chemist would ever dream of going back to what even now he would venture to call "old-fashioned" methods. In this respect, however, there is the great compensation that the technique of micromethods has been subject to such intensive study that in many cases they may realise a higher accuracy than the ordinary micromethods.

The advantages of micromethods are three-fold. Economy in use of material to be analysed is theoretically the first and most obvious reason why micromethods were developed, and this aspect no doubt appeals to the chemist engaged in complicated syntheses, where yields may literally be microscopic in some cases, and also to the medical and biochemists often concerned with the chemistry of minor constituents. Secondly, there is economy in time of analysis; on the average microanalysis can save at least half of the time spent on analytical determinations. Thirdly, there is economy in regard to reagents, apparatus, services (gas, electricity and water) and bench room.

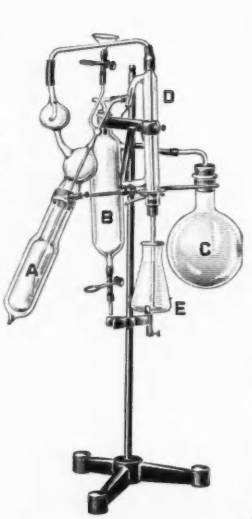


Combustion Furnace and Accessory Equipment for the Determination of Carbon and Hydrogen by Micromethods. (A. Gallenkamp & Co.).

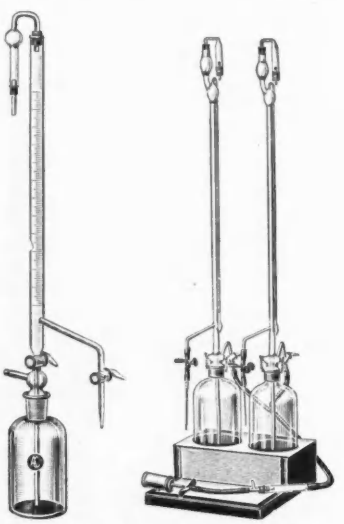
Economy in time of analysis is of paramount importance in an industrial laboratory. When one bears in mind also the increased accuracy capable of being realised by microanalysis it will be agreed, said Mr. Strafford, that there is often a very strong case for its adoption in an industrial



Digestion Stand complete with Vapour Tube for connection to Vacuum Pump and six Digestion Flasks, for the Determination of Nitrogen by Micro-Kjeldahl method. (A. Gallenkamp & Co.).



Distillation Apparatus for the Determination of Nitrogen by Micro-Kjeldahl method. (A Gallenkamp & Co.).



Left: **Micro-Burette 10 ml. in 1/20ths, with 500 ml. Reservoir.** *Right:* **Titration outfit comprising two Burettes with Automatic Zero. (A. Gallenkamp & Co.).**

analytical laboratory of any importance. As an example of time saving it may be mentioned that a carbon-hydrogen determination by combustion can be completed in an hour and a quarter. In the case of a different type of microanalysis, by colorimetry, it is possible to carry out a colorimetric determination of nickel in 0.1 gram of a copper-nickel alloy in ten minutes: this contrasts very favourably with the time required by the classical methods.

Acquiring the necessary technique to carry out accurate microanalysis is an excellent discipline and training for a young chemist. Micromethods can be applied to the whole field of chemical analysis, and they can be classified into the three usual groups according to the manner in which the determination form is measured, *viz.*, (1) gravimetric, (2) volumetric, including measurement of gas volumes, metallic spheres or standard solutions, (3) optical, including all forms of colorimetry and spectroscopy.

Gravimetric Analysis

As far as purely gravimetric analysis is concerned, using an ordinary microbalance, only milligram or 10^{-3} analysis is generally possible, but in cases where volumetric determinations come in it is possible to reduce the technique to the gamma or 10^{-6} scale, by using special microburettes of small capacity. These "gamma" methods are used more particularly in biological and medical work. Micro-gravimetric and volumetric analysis can be dismissed briefly by indicating that they are essentially reduced scale macro-methods, involving the use of special small-scale apparatus and technique. Particular reference might perhaps be made to Emich's method of three weighings, which involves the use of the inverted filter stick and the microbeaker, which are weighed together on the microbalance. The sample is then introduced into the microbeaker and the ensemble weighed again. Then the solution, precipitation and filtration are carried out in the same beaker with the same filter stick and finally both are dried, or ignited, and weighed together. Errors due to *transference* are thus avoided. The technique of this type of microanalysis is described with wealth of detail in the publications of Emich and of Pregl, useful companions to which are the Institute of Chemistry publication on "Microanalytical Methods" by Professor Briscoe and Dr. Janet Matthews.

Determination of Minor Constituents

Colorimetric and spectroscopic methods may also be applied, if necessary, as "gamma" methods. These methods are perhaps of great value in the determination of minor constituents, *e.g.*, of trace metals in alloys and of metallic impurities in food colouring materials. At the same time, I consider there is a good case for using colorimetric methods for determination of *major* constituents to a far greater extent than is at present general custom. Colorimetric methods are capable of affording an accuracy within ±0.5 per cent. absolute under suitable conditions, and there must be many cases where such a degree of accuracy is all that is required. For it must be remembered that colorimetric methods are often extremely time-saving. They can be classified as true micro-methods on account of their great sensitivity, even though one need not use a microbalance or any special technique. The micro-scale is realised by using suitable aliquots of the test solution containing a known weight of the sample. For determination of traces the method is already a micro one if directly applied to a few grams of sample.

In the field of organic chemistry, colour reactions are as a rule due to the presence of a characteristic group rather than to the molecule as a whole; consequently, there are relatively few reactions which are sufficiently selective to serve as an infallible test for a single substance. In both qualitative and quantitative investigations, therefore, the application of the colour test is often necessarily preceded by separation from interfering substances. For this, resort may be made to the usual methods of organic chemistry, including precipitation, distillation, and steam distillation, or in special cases it may be possible to destroy the interfering substance or to convert it to other compounds which have no influence on the colour test. The latter principle is employed in the method we have devised for the colorimetric determination of pyridine in nicotine: the nicotine is destructively oxidised by boiling with potassium permanganate solution; pyridine is entirely unaffected and may be recovered by steam distillation and determined by the extremely sensitive aniline-cyanogen bromide method. In this way as little as 0.05 per cent. pyridine can be determined in a 0.25 gram sample of nicotine ("Analyst," 1933, *58*, 380).

Colorimetric Reactions

The scope of colorimetric reactions in the organic field is widened by reason of the fact that it is often possible to convert a compound to be determined into one which is capable of giving a sensitive colour reaction. As an example, traces of nitrobodies may be determined by reducing with zinc dust in acid solution, followed by colorimetric determination of the aromatic amines produced. Again, benzoyl peroxide in flour is determined by quantitative conversion to benzoic acid, which is in turn oxidised to salicylic acid by ferric chloride and hydrogen peroxide under controlled conditions. A constant 12.5 per cent. of the benzoic acid is oxidised to salicylic acid; consequently, a colorimetric determination of the latter affords a measure of the benzoyl peroxide. It should also be remembered that there has been a great deal of other work carried out in organic qualitative analysis, notably in the detection of the alkaloids and many pharmaceutical products, mainly using tests involving crystal formation and investigation under the microscope, melting point determinations under the microscope, sublimation, and other methods of preparative microchemistry.

Possible Errors by Direct Vision

In direct vision methods, *e.g.*, using Nessler cylinders or a Dubose colorimeter the ultimate accuracy depends on the sensitivity of the eye and the extreme error is normally not less than about ±2 per cent. and may be as high as ±10 per cent. or more, depending on the colour response of the observer's eye, the sensitivity of the colour reaction and the method employed in colour matching. The extreme error of the well-known colloidal sulphide method for lead is as much as ±7.5 per cent.; this has been shown to be mainly due to lack of reproducibility of the colloidal suspension. In the dithiozone method in which the coloured lead complex is in *true solution* (in chloroform) the error is ±4 per cent. by visual (Lovibond) measurements, or ±2 per cent. by measurement by photoelectric cell. In this case, the most of the error is due to slight lack of reproducibility of the coloured solution rather than to the error of the photoelectric measurement of relative colour intensity which is certainly accurate to within ±0.5 per cent. In the case of determination of copper by diethyl dithiocarbamate, the extreme error of the direct visual method is no more than ±2.5 per cent.

Nitric Acid Production in Japan

THE continued activity of the explosives, dyestuffs and nitrocellulose industries in Japan has stimulated the demand for nitric acid and caused a marked increase in production. At present there are four important producers, namely: The Miike Chisso Co., the Nihon Chisso Co., Sumitomo Chemical Co., and Yahagi Kogyo Co. The Showa Fertiliser Co. has just completed a plant at Kawasaki, near Tokyo, and has conducted trial operations. This plant is reported to have an annual capacity of 5,000 metric tons and the company expects also to produce ammonium nitrate and sodium nitrate. According to official figures of the Department of Home Affairs, production of nitric acid in 1933 amounted to 36,880 tons, rising to 43,217 in 1934. The 1935 production was estimated at approximately 47,000 tons.

Midland Chemists' Dinner

Joint Chemical Council Warmly Welcomed

THE Midland chemists' annual dinner and dance organised by a committee representing the local sections of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry, was held at the Midland Hotel, Birmingham, on February 29. Mr. A. W. Knapp presided, and in the course of the evening he presented Mr. W. A. S. Calder, president of the Society of Chemical Industry, with a silver tankard, inscribed "From his friends, the Midland chemists."

Mr. H. W. Rowell proposed the toast "The Joint Chemical Council." He said the council was beginning to do at the headquarters of the three societies what Midland chemists had been doing for the past ten years. Each year they had been co-operating more successfully. Midland chemists were, in fact, responsible for the formation of the council, for they had made such a noise about co-operation that something had to be done about it. He admitted that the Joint Chemical Council scheme bore little resemblance to the more businesslike scheme which they had put forward some years ago, but the council had started well, for it had appointed Dr. Pickard as its chairman. The speaker hoped Dr. Pickard would eventually guide the council into such a policy that it would look upon its charter quite liberally. Midland chemists would co-operate in any scheme brought forward by the council that would help to unify the different chemical societies into one practical working unit.

Dr. R. H. Pickard, president of the newly-formed joint Chemical Council, responded to the toast. He said it was true the provinces had set an example to headquarters, and of all the provinces the Midlands had provided the best-known example of co-operation. He congratulated them upon it. There was a large number of chemists in the country, a good proportion of them members of one or more of the three bodies. These three bodies at the moment contained over 11,000 members of the profession of chemistry, and their representatives at long last had come to some measure of common agreement—a very small measure—and were trying to set their house in order.

They had come to the conclusion that they could not carry on in the old way any longer. The chemist had at least two tools. There was the searching out of knowledge already gained and the striving to find and communicate to other chemists the knowledge that was being obtained; and in these two forms—library and publication—they had been in very great difficulties. The biggest chemical library in the world was in the nominal possession of the Chemical Society, but the building was too small and would only hold the publications of a further two years. In these circumstances they had arranged that each individual chemist should contribute the same individual amount towards the maintenance.

They were attempting to rationalise, or rather to centralise, the business control of their publications, and hoped to save money in that way. The three chartered bodies were co-operating to save money, and in order that their publications might be bettered. Both the Chemical Society and the Society of Chemical Industry were having to draw upon invested funds, while the Institute of Chemistry just paid its way. If they could by co-operation, rationalisation and economies provide for the individual chemist better tools, they would then be in a position to go to industry as a united body and justifiably plead that industry should do something to assist the learned societies in maintaining and exending their library, in publishing new knowledge and in making that new knowledge accessible to chemists.

Cold-Setting Refractory Cements

Investigation at the U.S. Bureau of Standards

COLD-SETTING refractory cements are a comparatively new addition to the refractories field and since their consumption has increased rapidly during the past 10 years, a real need for this material apparently exists. A cold-setting refractory cement, as its name implies, will set up or harden without the application of heat, and at the same time because of its refractory ingredients will form a ceramic bond at high temperatures. The ability of a cement to develop and retain strength over a wide temperature range is a very desirable asset since it may then be used in all parts of a furnace installation without danger of any of the refractories working loose during operation of the furnace.

The necessity for evaluating certain properties of these cements is evident in order to aid the consumer to choose those most suitable for his purpose. With that end in view the United States Bureau of Standards has undertaken a study and has obtained results in preliminary tests which show that the bonding strength of a cement is dependent on the type of fire-clay refractory with which it is used. For this purpose four different types of cold-setting fire-clay cements received in the wet condition were studied with respect to water content, drying shrinkage, particle size, pyrometric cone equivalent (softening point), and transverse strength. Also, five brands of fire-clay brick were studied with respect to rate of water absorption and transverse strength. The unheated bonding character of each of the four cements was obtained with each of the five brands of brick by joining the 2½ by 4½ inch faces of two half bricks, using a 1/16 inch mortar joint. After drying, the strength of the joint was found by breaking the bonded brick transversely.

The transverse strength of the bricks ranged from 440 to 2,665 lb. per sq. inch and the total water absorption from 1.5 to 14.6 per cent. The transverse strength of the cements ranged from 900 to 3,415 lb. per sq. inch, the water content from 22.5 to 25.8 per cent., the drying shrinkage from 2 to 8 per cent., the sieve analysis showed from 0 to 15 per cent. retained on a No. 60 U.S. Standard sieve, and the pyrometric cone equivalent ranged from 27 to 31-32. The results obtained indicate that the bonding strength of the cement is greatly influenced by the type of brick with which it is used. In other words, if the cement properly bonds with the bricks, the strength of the joint varies with the strength of the brick and also with the rate of water absorption. As an example, the same cement when used with each of five different brands of brick showed a bonding strength ranging from 190 to 630 lb. per sq. inch. This information leads to the conclusion that some consideration must be given to the type of brick when a requirement for bonding strength is included in a specification for cold-setting refractory cements.

Applications of Duprene in Industry

An Interesting Paper Outlining American Practice

THE London and District Section of the Institution of the Rubber Industry availed itself of the visit to England of Mr. O. M. Hayden, of Du Pont de Nemours and Co., of America, who accepted the invitation to present a paper on the above subject at a meeting held at the British Empire Club, St. James's Square, London, on February 24. Dr. S. Pickles presided.

Introducing the subject of his paper Mr. Hayden said he liked to think of Duprene as an engineering material supplementary to rubber, a material not strictly a substitute for crude rubber but one particularly suited to special service conditions. If it were merely a substitute for natural rubber there would be little justification for its production. He discussed it from the point of view of a material for service conditions where it performed in a manner superior to natural rubber—in particular, where it filled the need for a rubber-like material having greater resistance to the action of oils and solvents and to the deteriorating influence of oxidation than had natural rubber. Other properties which accounted for some of its commercial uses were its resistance to the action of ozone, its relatively low permeability to gases, and the fact that Duprene cements impregnated porous bodies more thoroughly than rubber cements.

Wide Variation of Properties

Duprene, said Mr. Hayden, was made by passing acetylene over a catalyst to form mono vinyl acetylene, the latter was reacted with hydrochloric acid to form chloroprene. Chloroprene was a thin, clear liquid which was unstable, and it polymerised spontaneously to a plastic solid (Duprene) closely resembling the natural rubber of commerce. Like rubber, the physical properties of Duprene were susceptible of wide variations depending on the nature and amounts of vulcanising agents, reinforcing pigments, etc., compounded with it. One essential difference in the conditions necessary for vulcanising Duprene and rubber was that whereas sulphur in some form was necessary for the proper vulcanisation of rubber, its presence was not essential to the vulcanisation of Duprene. Many Duprene compounds contained sulphur because it imparted certain characteristics to the finished product, but many compounds contained no sulphur.

Uncompounded Duprene could be vulcanised by heat alone, but its strength, elasticity and durability were greatly enhanced by compounding it before vulcanisation with wood rosin, sulphur and certain metallic oxides. Wood rosin alone was not a vulcanising agent, but its presence was essential to the reactions brought about by the metallic oxides. The effect of wood rosin was due to the abietic acid which was its major constituent; commercial abietic acid could be used in place of wood rosin, but it was more expensive and appeared to produce no better results. Sulphur was used as an accelerator of vulcanisation, with wood rosin and a metallic oxide, to reduce the time to cure, to increase the moduli and to reduce the permanent set and cold flow of the vulcanisate. Also, it improved the resistance of Duprene compositions to the aromatic solvents. Sulphur was omitted from Duprene compounds to be used at elevated temperatures because it decreased their resistance to heat; and from compositions used in contact with polished metal, because of the corrosive action of sulphur.

Compounding Ingredients

Extra light calcined magnesia was perhaps the most important Duprene compounding ingredient. It was always used in conjunction with zinc oxide or litharge, and when so used it increased the modulus and tensile strength of the vulcanisate, prevented scorching during mixing and processing; and neutralised such small amounts of hydrogen chloride as may be evolved when Duprene was exposed to strong sunlight or subjected to very severe oxidising conditions. A great deal of care should be exercised in selecting the proper grade of magnesia to use.

In a brief discussion of accelerators, antioxidants and reinforcing pigments, Mr. Hayden said there was no filler for Duprene that gave such satisfactory results from every point of view as carbon black; consequently, no coloured Duprene stock could be of such good money value as a black stock. He summarised the selection of carbon blacks as follows: (1) Use channel black only in stocks that must have the highest possible abrasion resistance; (2) use the very soft non-reinforcing blacks for all but the most severe conditions of service; they give snappy cures, can be used in very high proportions and are the most economical pigments for Duprene compounding; (3) use the intermediate or semi-reinforcing blacks for harder stocks and specially those which must have fairly high tensile strength, good oil resistance and low cold flow; (4) for high-quality hard stocks, use a combination of channel black, with the semi-reinforcing types of carbon black.

Processing of Duprene

Discussing the characteristics of unvulcanised Duprene that were of importance in connection with processing, Mr. Hayden pointed out that it was thermoplastic, it was not progressively softened by continued milling; that zinc oxide and litharge were vulcanising agents for Duprene compounds and in mixing they should be the last ingredient added; and that light calcined magnesia and wood rosin (the former, a preventative of scorching, being assisted by the latter) should be added one with the other early in the mixing process.

The mixing of Duprene compounds should proceed as rapidly as possible on cool rolls in order to reduce heat generated during the mix. As soon as the Duprene sheeted on the roll, the rolls should be adjusted so that there was only a small rolling bank. As soon as the mill was adjusted for a small rolling bank, the light calcined magnesia should be added; and while this dry pigment was on the bank, the wood rosin should be added. If no liquid softeners were used in the compound the rosin should be finely powdered and then stirred into the magnesia before adding to the Duprene. But since practically all Duprene compounds contained liquid softeners in addition to wood rosin, it was advisable to make a composite of them by melting the wood rosin into the cotton seed oil or mineral oil used. When coumarone resins were also used they should be included in the melted softener mix. When a blend of wood rosin and liquid softeners was used, only a part of it should be added with the magnesia; the remainder should be used to speed up the incorporation of carbon black, clay, whiting or other dry fillers. The fillers, together with the antioxidant and sulphur, were added to the batch as rapidly as possible. To add factice, one should cut the batch into the pan and place the factice on the bare mill rolls. When the factice had become crumbled, both it and the Duprene should be placed on the mill and one should cut back and forth four or five times for blending. Zinc oxide should be added last, and when it had been incorporated one should cut the batch 15 or 20 times for blending. Sheeting off should be done in single sheets and they should be cooled before storing, by dipping in a water tank or spraying with water.

A Useful Accessory

A " doctor " knife or back roll scraper was a most useful accessory on a mill for mixing Duprene compounds; it might cut the mixing time in half where the compound was of the nature which would stick badly to the back mill roll. Duprene batches could be mixed in internal mixers.

The calendering of Duprene stocks required very careful adjustment of calender roll temperatures. The bank on the calender should be kept as small as possible. The top roll of the calender should be maintained at a slightly higher temperature than the middle roll. Duprene compounds tended to cling to the cooler of any two rolls with which it was in contact, and in order to prevent it going to the top roll, the middle was always run a little cooler. The roll temperatures for Duprene mixes would be lower than for rubber mixtures. Duprene would not friction well on cool fabric; the fabric must be quite warm to obtain the best results. Usually little trouble was experienced with frictioning dry, warm, square-woven fabric, but it was usually necessary to spread cord fabric. The best calender roll temperatures for frictioning high-quality Duprene stocks appeared to be top roll 80° C., middle 70° C. and bottom roll 90° C. In general, Duprene compounds would tube more easily, more smoothly and faster than rubber compounds.

Application of Solvent

With regard to assembling, Mr. Hayden said that Duprene must be clean, fresh and warm in order to adhere to itself properly. Dry stocks should be freshened by wiping with a cloth saturated with toluol, which was better for that purpose than was benzol or carbon tetrachloride because it evaporated more slowly and the tacky surface was retained for a greater length of time. As with rubber, the solvent should be applied sparingly but thoroughly, a good prescription being 50 per cent. solvent and 50 per cent. elbow grease! Cold raw Duprene stocks were usually dry and leathery, so that it was difficult to obtain good adhesion with them. Unassembled Duprene compounds should be stored in a comfortably warm place, and preferably warmed up before they were assembled. It was more difficult to obtain good adhesion between Duprene and rubber than between Duprene and Duprene, probably due to the fact that they were not soluble in one another. Only fair adhesion could be obtained between Duprene and rubber if both surfaces were fresh, warm and clean. Washing the surfaces with toluene was of material assistance, and roughening the surfaces also helped. A still better way of adhering Duprene to soft rubber was by the use of intermediate stocks. By the use of special plastics, very satisfactory bonds had been obtained, and development was in progress.

For moulding, the best results were obtained when the raw stock was shaped carefully to the contour of the mould and was so prepared that there was very little rind or overflow. Ordinary mould lubricants were satisfactory. As to spreading, Duprene cements and doughs were made by churning unvulcanised Duprene compounds in aromatic solvents or chlor substituted hydrocarbons. Duprene cements in general were better adhesives than rubber cements, because unvulcanised Duprene was tougher and less extensible than unvulcanised rubber; moreover, Duprene appeared to be unaffected by the process of dissolving it and removing the solvent for evaporation.

Some General Uses

In conclusion, Mr. Hayden reviewed some of the uses of Duprene, as in gaskets, washers and packings, printing rollers and blankets for newspaper and lithographic off-set printing, protective jackets for high tension wires and portable cables (outside the insulation) pump pistons and cups in oil slush pumps, Lux linings for hose conveying gasoline and oil, or propane and butane, high pressure grease gun hose. as a binder for transmission belts, covers for conveyor belts, hospital sheeting, balloon fabric, diaphragms for controllers, regulators and meters, adhesives, seals for prevention of refrigerator leakage, gloves for use in chemical plant, and for printing plates and engraving gums.

The pound cost of Duprene plastic polymer was several times that of natural rubber, but owing to its special properties for service conditions where natural rubber products had failed to give satisfactory service, Duprene was an economic commodity.

Duprene latex was made by emulsifying chloroprene in water and allowing it to polymerise under carefully controlled conditions. The resultant product resembled vulcanised natural rubber latex, but differed from it in that the average particle size was much smaller. Duprene latices had less tendency than natural rubber to coagulate due to agitation, but they coagulated very readily when subjected to pressure. Duprene latex contained neither bacteria, sugar, or proteins, and there was no danger of instability due to fermentation.

Borax Consolidated, Ltd.

Satisfactory Outlook for the Industry

PRESIDING at the 38th ordinary general meeting of Borax Consolidated, Ltd., in London on January 23, the Earl of Leven and Melville (the chairman) said that the company had benefited considerably from its plant additions and improvements, to which feature the directors gave continual attention. The outlook for the industry was promising; new uses for borax were being developed, and the industries, such as glass, enamelled iron, pottery and many others, on which the company relied for much of its business, were increasing their demands for borax.

A very interesting development had recently occurred. It had been determined that a small percentage of borax in the soil was essential to most plant growths, and that its presence prevented diseases in root-crops, as sugar-beet, turnips, etc., and it was now being introduced into the soil in various countries under expert advice from agricultural authorities. It was evident that this might lead to an important demand for borax. With the increasing demand and such new uses, and given a reasonable freedom in the movement of currencies, the future for the industry could be looked forward to with confidence. So far as the current year was concerned, the sales to date showed an increase over last year.

Far Eastern Chemical Notes

China

NITRIC ACID IS NOW BEING MADE at the Shanghai works of the Tien Lee Synthetic Nitrogen Products Co.

Manchukuo

UNCONFIRMED REPORTS HAVE BEEN PUBLISHED of the contemplated promotion of a coal liquefaction enterprise by Masahi (a former member of Parliament), with a capital of 5 million yen. It is understood that a new and cheap process will be operated.

Japan

RECENT INVESTIGATIONS CARRIED OUT IN FORMOSA have revealed the suitability of camphor oil as a raw material for synthetic dyestuffs. For example, the safrol obtained from camphor oil can be converted into aminodyhydro safrol which on diazotisation yields brown, orange and red azo dyes.

THE RECENTLY ANNOUNCED PRODUCTION PROGRAMME of the Sumitimo Chemical Co. includes potassium carbonate, urea, ammonium chloride, ammonium carbonate and trisodium phosphate. Apart from these, methyl alcohol and formaldehyde manufacture will actually be commenced in the course of the present year.

THE SOUTH SEA WOOD CO. (which stands in close relationship with the Oji Paper concern) is understood to be developing a new process for producing wood cellulose with a view to placing the requirements of Japanese cellulose—using industries upon a more satisfactory basis. Wood for this purpose will be imported from the Dutch Indies.

Refractories Research Association

An Effort to Extend its Activities

A CONFERENCE called by the British Refractories Research Association was held at the Hotel Metropole, on February 26, to consider extending the activities of the research association, which deals with the fire bricks and other fire-resisting materials for furnaces and retorts. A special appeal was made for the extension of its activities to research on building bricks, tiles and other clay products. Strong pleas were also made for much stronger support from the pottery industry whose previous support had been very small.

Lord Rutherford, chairman of the Advisory Council of the Department of Scientific and Industrial Research, referred to the recent progress of the research association movement and said that some increase in recent years in the resources of the Refractory Association had been secured, but even so the subscription income from trade sources was under £5,000 a year, and the total income from all sources was only just over £8,000. The minimum income which the association ought to have to cope with work for all the interests concerned was not less than £20,000 a year, a sum which would represent less than £1 per £1,000 of output.

Sir Clement Hindley, chairman of the Committee of the Advisory Council which deals with grants to research associations, reviewed the history of the Refractories Research Association and its position to-day. From its inception in 1920 to 1932, that is, for 12 years, the association, he said, had received a grant from the Department on a £ for £ basis. In 1931-32 the industry produced a subscription income of £1,800 and received the same sum from the Department, together with a contribution from the Iron and Steel Federation of £500, making a total of just over £4,000 a year. In June, 1932, the minimum industrial income of the association increased to £5,000 a year, the users of refractories taking a prominent share in providing the increased income. Judging by the present size of the subscriptions to the association, it would seem, he said, that only about a third of the subscribers had real faith in the work and were convinced that money given for research was a good investment.

In conclusion, Sir Clement Hindley appealed to all industrialists and manufacturing interests present, which collectively represented a gross output of about 30 million sterling, to increase their support to the research association. "Surely," he said, "with interests of this magnitude, a total income of £20,000 a year does not seem an extravagant insurance premium for future prosperity."

What About Advertising?

Sir Ernest Benn on the Appeal to the Individual

SIR ERNEST BENN, president of the Advertising Association, was the guest of the Glasgow Publicity Club at luncheon on February 28. Speaking on "What About Advertising?" he said that few people realised that advertising to-day was a post-war conception. In his young days the great bulk of the population looked upon advertising as something rather disreputable and low class. It was the war which changed that attitude. He remembered very vividly the shock to the City of London when the Treasury actually spent money to buy space in the newspapers in order to get the War Loan over. Newspaper space was also bought for recruiting purposes. From that the entire conception of the advertising business had changed. He wanted to make it clear to the public during his term as president of the Advertising Association that employment, advertising and distribution were linked up closely and definitely.

Advertising must appeal to the individual. They never heard of an advertising scheme designed to sell something to the Milk Marketing Board or the Royal Society of Medicine. They must concern themselves all the time with individual thought, individual wants and individual psychology.

World Power Conference

British Participation

THE Third World Power Conference and the Second Congress, International Commission on Large Dams of the World Power Conference, are to be held in Washington concurrently between September 7 and 12. Advance copies of the programme have been issued, and the British National Committee has appointed two papers committees:—

Electrical and General Engineering Papers, Mr. Roger T. Smith (chairman), Sir Harold Hartley, Colonel J. G. Fleming, Mr. E. E. Hoadley, Sir Cyril Hurcomb, Mr. J. M. Kennedy, Sir Archibald Page, Mr. C. Rodgers and Mr. C. D. Taite.

Fuel papers, Dr. C. H. Lander (chairman), Sir Harold Hartley, Dr. A. E. Dunstan, Colonel J. G. Fleming, Mr. E. J. Fottrell, Dr. F. S. Sinnatt, Dr. E. W. Smith and Mr. R. F. Taylor.

Arrangements are in course of completion for the preparation of a thoroughly authoritative collection of British papers. The British Committee on Large Dams has arranged for the preparation of several papers for presentation at the Second International Congress. The conference and congress will be preceded and followed by "study tours" an essential feature of which will be "round-table discussions" which will be linked up with the places of technical interest visited. As the questions to be dealt with at the plenary meeting are largely economic and administrative in character a due balance will be preserved by emphasising the technical character of the study tours and of the round-table discussions between specialists which will be associated with them. There will also be a post-conference transcontinental tour of about three weeks' duration, the cost of which will be low. Intending participants should apply to the British National Committee, World Power Conference, 36 Kingsway, London, W.C.2.

F.B.I. and the Budget

Industry's Case for Reduced Taxation

THE Federation of British Industries has presented to the Chancellor of the Exchequer the views of industry in regard to the forthcoming Budget. The Federation suggests that increasing prosperity should ensure that at a lower rate the yield of direct taxation should be no less than at present. A reduction would give the greatest possible encouragement and stimulus to industry, which would thereby be in a better position to meet any future emergency, and would still further stimulate the revival of trade. The Federation therefore asks for a reduction in the rate of income tax. It recognises that, owing to the necessity for renewing the defence requirements of the country, special considerations apply to the present time, and in the course of the next few years large sums of money will be needed to carry out the programme. It is not known how the Government proposes to finance this, but it would appear likely that in the next financial year outgoings may not be relatively high. Bearing this in mind, and having regard to the present favourable conditions prevailing in the money market, the Federation urges that, even taking into consideration the defence requirements, the soundest policy would be to reduce the income tax.

Reduction of Spirit Duty

Apart from reduction in income tax, the Federation recommends a reconsideration of the spirit duty. A substantial reduction in the present high rate of this duty would at an early date lead to a greater yield of revenue, while being of undoubted benefit to an important industry. The Federation supports the detailed recommendations of the Whisky Association, which are being forwarded separately to the Chancellor on this point.

Personal Notes

MR. H. FINNIS JOHNSON has been elected to a seat on the board of Borax Consolidated, Ltd.

MR. HARRY BOWES, F.I.C., F.C.S., of 7 Peel Moat Road, Heaton Moor, Lancashire, left £15,839, with net personalty £12,847.

PROFESSOR G. T. MORGAN has been appointed an examiner of theses presented for the degree of D.Sc. at the University of St. Andrews.

LORD READING, formerly president of Imperial Chemical Industries, Ltd., who died on December 30 last, aged seventy-five years, left gross estate valued at £290,487, with net personalty £261,091.

MR. RICHARD CADBURY, of Lower Wick House, Worcester, son of Mr. Richard Cadbury, of Cadbury Bros., Bournville, who died on December 14 last, aged 66 years, left estate of the gross value of £153,893 (net personalty £146,997).

MR. WILLIAM C. LEE, J.P., died on Monday at his residence at Burnside. He was a director of Peter Lee and Sons, Ltd., paint merchants and oil refiners, Glasgow, and was a native of the city. The firm was founded in 1875.

PROFESSOR FREDERICK GEORGE DONNAN, professor of chemistry in the University of London, and DR. FRANCIS CARTER TOY, deputy director of the British Cotton Industry Research Association, have had the title of Fellow of University College, London, conferred upon them.

MR. W. H. PENNINGTON, a former manager of the dye-house of the firm of Burgess, Ledward and Co., Ltd., Walkden, Lancs, died on February 23. He was 78 years of age. In 1882 he became manager of the weaving, dyeing and silk department of John Bright and Bros., Rochdale, where he remained until 1907 when he became manager of the dye-house of Burgess, Ledward and Co.'s mills. He retired several years ago. He was one of the founders of the Society of Dyers and Colourists, and when the Manchester section was formed he was elected chairman. For many years he was vice-president of the Society. He later became chairman of the Cotton Yarn Bleachers' Association. In 1929 a presentation was made to him in recognition of 60 years' service to the trade.

MR. THOMAS STENHOUSE has died at Rochdale aged 88. He was a borough analyst of Rochdale from 1882 to 1924.

SIR KINGSLEY WOOD, M.P., Minister of Health, will open the "Daily Mail" Ideal Home Exhibition at Olympia on March 24. More than 600 leading firms will exhibit.

MR. A. C. G. EGERTON, F.R.S., since 1921 reader in thermodynamics in the University of Oxford, has been appointed to the chair of Chemical Technology (Imperial College, Royal College of Science) of the University of London.

MR. D. OWEN EVANS, a director of the International Nickel Co. of Canada, has been elected a vice-president of the company. It is understood that he will continue as delegate director of the Mond Nickel Co. and its subsidiary companies, and will also remain in charge of the business in this country and Europe.

MR. W. F. BEARDSHAW, of Sandygate Park, Sheffield, died on February 28 in the South of France, aged 78. He was a past-president of the Sheffield Chamber of Commerce and of the Sheffield Society of Engineers and Metallurgists. He had been a member of the Iron and Steel Institute for nearly fifty years.

MR. FRED CLEMENTS, director and general manager of the Park Gate Iron and Steel Co., Ltd., Rotherham, has been awarded the Bessemer Gold Medal by the Iron and Steel Institute. Mr. Clements is a member of the Council of the Iron and Steel Institute, a member of the Industrial Research Council of the British Iron and Steel Federation, and chairman of the Blast-Furnace Committee of that organisation.

MR. W. R. BARCLAY, of Edgbaston, who will preside at the annual dinner of the Institute of Metals in London next Wednesday, is president-designate of the Institute. He was at one time a lecturer in electro-metallurgy at Sheffield University. He is a past president of the Birmingham Metallurgical Society and has been chairman of the Sheffield and Birmingham local sections of the Institute of Metals. Mr. Barclay was also an original member of the Council of the British Non-Ferrous Metals Research Association, and is now vice-president.

Continental Chemical Notes

Switzerland

A NEW MATCH FACTORY HAS BEEN BUILT at Untertertzen, where 60 employees are engaged in making both boxes and matches from Swiss pinewood.

Roumania

THE MILORI PRINTING INK WORKS, of Bucharest, which is now in active production, has been founded by the German ink-making firm of Gebrüder Schmidt in association with the "Casa Grafica," of Bucharest.

Russia

ALKALI AND ALPHA-NAPHTHOL have been used with success in a new process for refining cracked benzine at the "Mendelejeff" factory. Compared with the usual refining process using sulphuric acid and alkali, a 15 per cent. better yield of benzine is said to have been secured with the new method.

ON REACTING BENZENE AND AMMONIA in a high tension field, W. R. Rasoumov obtained varying yields of phenol, diphenylamine and aniline. It was found possible to control the process so as to give high yields of either aniline or diphenylamine ("Memoirs of the Ukrainian Institute of Chemistry," 1935, No. 3, 261).

France

RECENT COMPANY REGISTRATIONS include: S. A. pour l'Exploitation des Procédés Phogor, in Paris, with a capital of 225,000 francs (manufacture of plastic masses); Idaco, in Aubervilliers (Seine), with a capital of 250,000 francs (utilisation of animal waste products); Société d'Exploitation des Procédés L. Cerini, in Paris, with a capital of 100,000 francs (to operate a process for regenerating caustic soda used in rayon manufacture); Soc. de Produits Chimiques de Saint-Beuil, in Paris, with a capital of 1 million francs (manufacture of chemical products).

Germany

IN ADMIXTURE WITH PORTLAND CEMENT, waste bleaching earths are stated to form excellent building materials ("Chemiker-Zeitung," February 19). Concrete prepared with this ingredient is highly water-repellent and suffers no loss in strength. Waste bleaching earths are also reported to reduce the shrinking tendency of plaster and mortar and are excellent fillers for bitumen insulating masses and sheets. Bitumenised wood shavings in conjunction with used bleaching earths and portland cement yield a satisfactory reinforced flooring and sheeting material.

From Week to Week

THE 1936 MEMBERSHIP LIST of the Association of British Chemical Manufacturers has been issued in the form of a 22-page vest pocket booklet.

E. H. BUTLER AND SON, LTD., are to take over the business of manufacturing chemists carried on at 93 Humberstone Gate, Leicester, the firm to be known as "E.H. Butler and Son."

FIRE CAUSED DAMAGE roughly estimated at £70,000 on February 27 at the oilcake mills of J. and J. Cunningham, Ltd., Leith, a subsidiary company of Scottish Agricultural Industries, Ltd. The compound mill contained a quantity of machinery valued at £50,000, which was destroyed.

THE EVOLUTION OF THE FIRE BRIGADE was the subject of an address given by Mr. John Richmond, fire superintendent of Boots Pure Drug Co., Ltd., to the Nottingham Achilles Society recently. Mr. Richmond, who is a graduate of the Institute of Fire Engineers, dealt with fire brigade history from the great fire of London to the present day.

SHAREHOLDERS OF THE GLENBOIG UNION FIRECLAY CO. will meet on March 11 to consider a purchase offer made by General Refractories, Ltd. Shareholders in the Glenboig Union Co. have been offered £9 cash per £10 share, or, alternatively, eight 10s. shares in General Refractories, and holders may take partly cash and partly shares. The directors of the Glenboig Union Co. recommend acceptance.

THE SYNTHETIC PRODUCTION OF FAT FROM COAL is to be undertaken immediately by a new company which has been established at Witten in the Ruhr. The new concern has been founded by the Markische Soap Manufactory and the Persil-Henkel Works, at Dusseldorf. It is claimed that the new process will go far towards helping Germany to become self-supporting in the production of fats.

A MODERN CHEMICAL FACTORY is to be constructed on the site of the old gasworks at Dun Laoghaire, Co. Dublin, by Albright and Wilson, Ltd. The contractors, G. and T. Crampton and the Dublin Dockyard Co., are preparing the constructional steel and expect to have the factory ready in about three months' time. Forty men are at work clearing the site. Anxiety has been expressed by residents as to the effect of the factory upon the amenities of the borough and the Department of Industry and Commerce has been approached. Mr. Threlfall, managing director of the firm, has arrived at Dun Laoghaire to discuss the matter.

THE COURSE OF ACTION TO BE ADOPTED at Ebbw Vale Steelworks by Richard Thomas and Co. was announced by Sir William Firth, chairman of the directors, at Newport (Mon.), on March 2. He said that after the slag heaps had been smoothed out a start would be made with the coke ovens, and these would be followed in rotation by blast-furnaces, a melting shop and an American type of continuous rolling mill. "We hope to make about twelve thousand tons of bessemer pig-iron," Sir William said. "We are going to convert about five thousand tons into billets, and to turn the billets into tubes and ferro-concrete bars. Part of the balance of the metal will be converted into strip in the American mill." Some of the strip will pass to tinplate mills.

AT THE ANNUAL MEETING of the Nottingham section of the Society of Chemical Industry, held on February 28, the following officers were elected: Chairman, Mr. T. H. Gray; vice-chairmen, Dr. H. H. Barber, Dr. F. L. Pyman, and Mr. G. H. Rome; hon. treasurer, Mr. D. J. Law; hon. secretary, Mr. W. T. T. Ainsworth. A joint meeting with the Chemical Engineering and Road and Building Moaterials Groups followed, this being attended by Mr. W. A. S. Calder, president of the Society. A paper on "The corrosion of cements by waters and the effects of carbonic acid," by Dr. E. B. R. Prideaux, was read by Mr. B. G. Limmer, B.Sc. Mr. J. Ward read a paper on "The classification of hydraulic limes" and Mr. D. M. Wilson one on "Safe road surfaces."

THE BUSY INDUSTRIALIST has little time to spend to read long accounts of a city's industrial facilities, Birmingham has therefore issued, to coincide with the opening of the British Industries Fair, a booklet which gives all the essential information by means of attractive three-colour graphs, accompanied by the minimum of reading matter. Graphs and diagrams illustrate Birmingham's air, rail, road and canal facilities, the location of 42,000 municipal houses, and the development and administration of the city and its electricity, gas, transport, and water services. The booklet aims to furnish to the potential manufacturer all the information he would be likely to need in a preliminary survey of Birmingham's manufacturing facilities, and serves to introduce the services of the municipal information bureau. It marks a further advance in the type of literature issued by municipal development organisations, in that it considers the facilities of Birmingham and the Midlands in relation to the industrial life of the country as a whole, and not merely as an isolated economic unit. Copies may be obtained from the information bureau at the Council House, Birmingham, or from the organisation's stand at the Birmingham section of the British Industries Fair.

PYROPHOSPHATE AND CREAM POWDER CO., LTD., baking powder manufacturers, etc., Tower Bridge Road, S.E.1, have changed their name to Phosphates, Ltd.

THE BUSINESS OF VINTONA CO., manufacturing chemists, Derby, has been formed into a limited company to be known as the Vintona Co., Ltd., with Mr. F. J. Crosley as managing director.

LANCEGAYE SAFETY GLASS CO. has acquired the majority of the issued share capital of Gilt-Edge Safety Glass, Ltd., a private company operating at Stone, Staffs, which manufactures tempered and laminated safety glass and also decorative glass. The purchase price has been satisfied in fully-paid shares of the Lancegaye Company, being part of the unissued capital.

VALUABLE EXPERIMENTAL MACHINERY WAS DESTROYED and irreplaceable records of experiments lost in a fire which greatly damaged the research laboratory of the Anchor Chemical Co., Clayton Lane, Clayton, Manchester, on March 2. The fire occurred at lunch-time, when none of the staff were in the laboratory. Regardless of the danger from bursting bottles and chemicals, firemen and members of the staff dashed repeatedly through the smoke and flames to save records and stock.

THE BRITISH STANDARDS INSTITUTION has issued a standard specification for Kohlrausch flasks (No. 615, of 1936). The specification provides for 50 ml., 100 ml. and 200 ml. flasks and gives details of dimensions, construction and tolerances for each size. An appendix has also been added giving particulars for additional Kohlrausch flasks for beet sugar laboratories. The National Physical Laboratory has arranged to accept Kohlrausch flasks for examination for conformity with the specification.

THE CHEMICAL SOCIETY will hold its anniversary meetings at Bristol on April 16 and 17. This is the first occasion on which the meetings have been held in the West of England and it is hoped that they will be well attended. A reception committee has been appointed, with Dr. S. H. Badock, pro-chancellor of the University, as chairman, and Dr. E. B. Maxted as hon. secretary, and an outline programme has been issued. The annual dinner will be held on the evening of April 16, and Professor T. S. Moore will deliver the Hantzsch memorial lecture on the morning of April 17.

A NEW TYPE of tooth powder container, known as the air flow flask, has been evolved by Calvert's, makers of carbolic tooth powder. The container, which is made of tin, is so designed that when it is pressed between finger and thumb, a convenient quantity of powder for each cleansing is ejected on to the tooth brush. The container is flat and triangular in shape, with rounded corners and edges, and is designed to fit the hand comfortably. It stands upright, and has a screw-cap. Calvert's were responsible for the basic idea of the container, and it was interpreted and designed by the display department of the company's advertising agents, the J. Walter Thompson Co., Ltd.

E. I. DU PONT DE NEMOURS AND CO., in their report for 1935, reveals the sale of its 49 per cent. interests in Nobel Chemical Finishes and Leathercloth Proprietary, to Imperial Chemical Industries. Formerly the I.C.I. held a 51 per cent. interest in these two companies. Nobel Chemical Finishes manufactures the entire du Pont range of Pyroxlin finishes in the British Empire, except Canada and Newfoundland. It was registered in England in 1906 as New Explosives Co. (1906). The name was changed to Necol Industrial Collodions in 1921, and to its present title in 1926. The authorised capital is £800,000, in 150,000 six per cent. preference and 650,000 ordinary shares of £1 each. Leathercloth Proprietary is an Australasian company. It was formerly known as Nobel Chemical Finishes (Australia) and manufactures fabrikoid and rubber-coated goods.

ACCORDING TO THE "FINANCIAL TIMES" (Montreal), the National Research Laboratories at Ottawa have recently achieved marked success in several fields of investigation. In one particular, namely, the scientific study of the natural gas resources of Alberta, now going to waste in huge quantities, has resulted in definite advances. It is now possible to produce from Turner Valley "stabiliser" gas, ordinarily wasted, a benzol suitable for motor fuel to the extent of nearly three gal. per thousand cu. ft. of gas. The process depends essentially on the heat treatment of the gas, and the work also appears to have solved satisfactorily some of the technical difficulties involved in the use of alloy steel at the high temperatures encountered. Definite advances have also been made in the production of ethylene, a starting material for the manufacture of industrial alcohol, anti-freeze, etc., and carbon black. This is a material used for the manufacture of printing inks and as an important ingredient in the manufacture of automobile tyres, and at the moment is being imported into Canada to the extent of more than a million dollars' worth annually. A process has been developed whereby yields can be had three to ten times as great as those obtained in the present commercial plants. The experimental laboratory stage has been completed and the plan awaits development by commercial interests.

Chemical and Allied Stocks and Shares

THE new Stock Exchange account which began on Monday has shown a continuance of active business in the industrial section. In view of the further official information as to the plans for re-equipping the defence forces there has been a disposition for interest to centre on shares of iron and steel and those of other companies whose products are expected to be in larger demand in this connection. Nevertheless the activity in industrial shares has been general and many shares have participated in the upward movement. Among shares of chemical and kindred companies there were again numerous points of interest. Imperial Chemical continued to show a good deal of activity on the wider realisation that the market is looking for the maintenance of the dividend at 8 per cent. Salt Union have shown some recovery from the set-back which followed the disappointment in the market that the dividend is not to be increased. William Blythe 3s. ordinary shares were again active on favourable dividend estimates. Lever Brothers' preference came in for steady demand, it being expected that the forthcoming results will show the company has again had a successful year. Associated Portland Cement have been very prominent on the large increase in the dividend. The view persists in the market that sooner or later there is likely to be some form of share bonus. British Cyanides continued to receive attention, it being felt in the market that the company's business may be reaching the stage when profits will increase more rapidly and when a favourable increase in dividend is likely. Fison Packard have been relatively steady. There are anticipations in the market that a larger interim dividend is likely. Cooper, McDougall and Robertson were steady, awaiting the past year's results. Imperial Smelting have continued more prominent. Boots Pure Drug were in steady request on any reaction in the price. B. Laporte have been in demand at higher prices. British Oxygen were good, partly on the belief that increased shipbuilding and other forms of industrial and engineering activity may raise the demand for industrial gases. Some market men are now taking the view that despite the larger capital there may be an increase in the dividend. Reckitt and Sons' ordinary have been very firm and have continued to hold the good improvement of a short time ago. This is one of the companies, which according to market views, may distribute a bonus sooner or later. Lawes Chemical showed more business and have held their recent further rise. There have been some rather sharp fluctuations in International Nickel in common with the majority of internationally-dealt-in shares. Pinchin Johnson were fairly steady, awaiting declaration of the final dividend, which can be expected about the middle of this month if last year's course is followed. Goodlass Wall remained firm, aided by the favourable estimates of the dividend. British Glues and Chemicals were unchanged. At 8s. 1½d. they are quoted at rather more than twice their nominal value, there being anticipations that despite the conservative policy invariably followed by the directors, the shares can be expected to re-enter the dividend list this year, now all the arrears of preference dividend have been paid. Bradford Dyers remained dull, in common with most cotton textile shares. A feature of interest was a large advance in Borax Consolidated deferred which are 27s. 9d. at the time of writing, compared with 25s. a week ago. Consett Iron have been firm, awaiting the full details of the proposed capital reconstruction scheme. Dorman Long issues were active in common with most other leading iron and steel shares. There has again been good demand reported for the 4s. shares of Blythe Colour Works which are around 11s. 6d. United Premier Oil and Cake were steady. United Molasses were again rather less prominent, although the market is continuing to talk of a larger dividend for the year and of the possibility of an interim dividend before long. There was active business in most of the leading oil shares. Trinidad Leaseholds reached the £5 level at one time in response to the growing belief that the dividend for the year may be raised to 25 per cent.

Name.	March 3.	Feb. 25.
Anglo-Iranian Oil Co., Ltd. Ord.	93/9	90/7½
,, 8% Cum. Pref.	36/-	36/-
,, 9% Cum. Pref.	37/-	37/-
Associated Dyers and Cleaners, Ltd. Ord.	1/10½	1/10½
,, 6½% Cum. Pref.	6/3	6/3
Associated Portland Cement Manufacturers, Ltd. Ord.	87/-	79/-
,, 5½% Cum. Pref.	28/-	28/-
Benzol & By-Products, Ltd. 6% Cum. Part. Pref.	3/9	2/6
Berger (Lewis) & Sons, Ltd. Ord.	70/-	70/-
Bleachers' Association, Ltd. Ord.	6/3	6/3
,, 5½% Cum. Pref.	11/10½	12/6
Boake, A., Roberts & Co., Ltd. 5% Pref. (Cum.)	20/-	20/-
Boots Pure Drug Co., Ltd. Ord. (5/-)	56/9	57/-
Borax Consolidated, Ltd. Pfd. Ord. (£)	115/-	115/-
,, Defd. Ord.	28/-	25/-
,, 5½% Cum. Pref. (£10)	£12	£11/17/6
,, 4½% Deb. (1st Mort.) Red. (£100)	£107/10/-	£107/10/-
,, 4½% 2nd Mort. Deb. Red. (£100)	£105/10/-	£105/10/-
Bradford Dyers' Association, Ltd. Ord.	8/1½	8/9
,, 5% Cum. Pref.	11/10½	11/3
,, 4% 1st Mort. Perp. Deb. (£100)	£86/10/-	£86/10/-
British Celanese, Ltd. 7% 1st Cum. Pfd.	25/-	25/-
,, 7½% Part. 2nd Cum. Pref.	21/9	22/-
British Cotton & Wool Dyers' Association Ltd. Ord. (5/-)	6/3	6/3
,, 4% 1st Mort. Deb. Red. (£100)	£96	£96
British Cyanides Co., Ltd. Ord. (2/-)	4/3	4/3
British Drug Houses, Ltd. Ord.	21/3	21/3
,, 5% Cum. Pref.	21/10½	21/10½
British Glues and Chemicals, Ltd. Ord. (4/-)	8/1½	8/1½
,, 8% Pref. (Cum. and Part.)	30/-	30/-
British Oil and Cake Mills, Ltd. Cum. Pfd. Ord.	48/9	48/9
,, 5½% Cum. Pref.	25/7½	25/7½
,, 4½% First Mort. Deb. Red. (£100)	£107/10/-	£107/10/-
British Oxygen Co., Ltd. Ord.	123/9	122/6
,, 6½% Cum. Pref.	32/6	32/6
British Portland Cement Manufacturers, Ltd. Ord.	88/9	93/9
,, 6% Cum. Pref.	30/-	30/-
Bryant & May, Ltd. Pref.	67/6	67/6
Burt, Boulton & Haywood, Ltd. Ord.	20/-	20/-
,, 7% Cum. Pref.	27/6	27/6
,, 6% 1st Mort. Deb. Red. (£100)	£102/10/-	£102/10/-
Bush, W. J., & Co., Ltd. 5% Cum. Pref. (£5)	112/6	112/6
,, 4% 1st Mort. Deb. Red. (£100)	£96/10/-	£96/10/-

Name.	March 3.	Feb. 25.
Calico Printers' Association, Ltd. Ord.	8/1½	8/9
,, 5% Pref. (Cum.)	12/3	12/3
Cellulose Acetate Silk Co., Ltd. Ord.	12/10	13/5½
,, Deferred (1/-)	2/4½	2/4½
Consett Iron Co., Ltd. Ord.	13/6	12/9
,, 8% Pref.	37/6	35/-
,, 6% First Deb. stock, Red. (£100)	£110/10/-	£109/10/-
Cooper, McDougal & Robertson, Ltd. Ord.	37/6	38/9
,, 7% Cum. Pref.	30/-	30/-
Courtaulds, Ltd. Ord.	53/1½	56/10½
,, 5% Cum.	26/3	26/3
Crosfield, Joseph, & Sons, Ltd. 5% Cum. Pre-Pref.	25/7½	25/-
,, Cum. 6% Pref.	28/9	28/9
,, 6½% Cum. Pref.	31/10½	31/10½
,, 7½% "A" Cum. Pref.	32/6	32/6
Distillers Co., Ltd. Ord.	101/3	102/6
,, 6% Pref. Stock Cum.	32/-	32/-
Dorman Long & Co., Ltd. Ord.	27/6	28/9
,, Pref. Ord.	41/3	40/-
,, 6½% Non-Cum. 1st Pref.	25/-	24/9
,, 8% Non-Cum. 2nd Pref.	25/7½	26/3
,, 4% First Mort. Perp. Deb. (£100)	£103/10/-	£103/10/-
,, 5% 1st Mort. Red. Deb. (£100)	£105/10/-	£106/10/-
English Velvet & Cord Dyers' Association Ltd. Ord.	4/4½	4/4½
,, 5% Cum. Pref.	7/6	7/6
,, 4% First Mort. Deb. Red. (£100)	£72/10/-	£72/10/-
Fison, Packard & Prentice, Ltd. Ord.	45/7½	45/7½
,, 7% Non-Cum. Pref.	31/3	31/3
,, 4½% Debs. (Reg.) Red. (£100)	£106	£106
Gas Light and Coke Co.	28/-	28/-
,, 3½% Maximum Stock (£100)	£90/10/-	£89/10/-
,, 4% Consolidated Pref. Stock (£100)	£108/10/-	£108/10/-
,, 3% Consolidated Deb. Stock, Irred. (£100)	£92/10/-	£92/10/-
,, 5% Deb. Stock Red. (£100)	£118/10/-	£118/10/-
,, 4½% Red. Deb. Stock (1960-65) (£100)	£115/10/-	£115/10/-
Goodlass Wall & Lead Industries, Ltd. Ord. (10/-)	15/7½	15/7½
,, 7% Prefd. Ord. (10/-)	13/9	13/9
,, 7% Cum. Pref.	30/-	30/-
Gossage, William, & Sons, Ltd. 5% 1st Cum. Pref.	24/4½	24/4½
,, 6½% Cum. Pref.	30/-	30/-
Imperial Chemical Industries, Ltd. Ord.	40/-	39/6
,, Deferred (10/-)	9/7½	9/7½
,, 7% Cum. Pref.	34/-	34/-

Name.	March 3.	Feb. 25.
Imperial Smelting Corporation, Ltd. Ord.	18/-	18/3
,, 6½% Pref. (Cum.)	25/7½	25/7½
International Nickel Co. of Canada, Ltd. Cum.	$52	$52
Johnson, Matthey & Co., Ltd. 5% Cum. Pref. (£5)	105/-	105/-
,, 4% Mort. Deb. Red. (£100)	£98/10/-	£98/10/-
Laporte, B., Ltd. Ord.	117/6	112/6
Lawes Chemical Co., Ltd. Ord. (1/-)	9/4½	9/4½
,, 7% Non-Cum. Part Pref. (10/-)	10/-	10/-
Lever Bros., Ltd. 7% Cum. Pref.	32/6	33/-
,, 8% Cum. "A" Pref.	33/6	33/6
,, 20% Cum. Prefd. Ord.	80/-	80/-
,, 5% Cons. Deb. (£100)	£108/10/-	£108/10/-
,, 4% Cons. Deb. (£100)	£106/10/-	£106/10/-
Magadi Soda Co., Ltd. 12½% Pref. Ord. (5/-)	1/3	1/3
,, 6% 2nd Pref. (5/-)	6d.	6d.
,, 6% 1st Debs. (Reg.)	£15	£15
Major & Co., Ltd. Ord. (5/-)	7½d.	7½d.
,, 8% Part. Prefd. Ord. (10/-)	9d.	9d.
,, 7½% Cum. Pref.	1/6¾	1/6¾
Pinchin, Johnson & Co., Ltd. Ord. (10/-)	43/6	44/-
,, 1st Pref. 6½% Cum.	32/-	32/-
Potash Syndicate of Germany (Deutsches Kalisyndikat G.m.b.H.) 7% Gld. Ln. Sr. "A" and "B" Rd.	£74/10/-	£77
Reckitt & Sons, Ltd. Ord.	118/9	120/-
,, 4½% Cum. 1st Pref.	24/4½	24/4½
Salt Union, Ltd. Ord.	45/-	50/-
,, Pref.	47/6	47/6
,, 4½% Deb. (£100)	£107/10/-	£107/10/-
South Metropolitan Gas Co. Ord. (£100)	£126/10/-	£127/10/-
,, 6% Irred. Pref. (£100)	£149/10/-	£149/10/-
,, 4% Pref. (Irred.) (£100)	£105	£105
,, Perpetual 3% Deb. (£100)	£89/10/-	£89/10/-
,, 5% Red. Deb. 1950-60 (£100)	£115/10/-	£115/10/-
Staveley Coal and Iron Co., Ltd. Ord.	51/10½	53/1½
Stevenson & Howell, Ltd. 6½% Cum. Pref.	26/3	26/3
Triplex Safety Glass Co., Ltd. Ord. (10/-)	90/-	89/4½
Unilever, Ltd. Ord.	33/1½	35/-
,, 7% Cum. Pref.	31/-	31/9
United Glass Bottle Manufacturers, Ltd. Ord.	45/-	44/6
,, 7½% Cum. Pref.	32/6	32/6
United Molasses Co., Ltd. Ord. (6/8)	25/7½	25/7½
,, 6% Cum. Pref.	26/3	26/3
United Premier Oil & Cake Co., Ltd. Ord. (5/-)	11/-	11/6
,, 7% Cum. Pref.	25/7½	25/7½
,, 4¾% Deb. Red. (£100)	£104	£104

Inventions in the Chemical Industry

THE following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Specifications Open to Public Inspection

INSOLUBLE AZO DYESTUFFS, manufacture.—I. G. Farbenindustrie. Aug. 11, 1934. 17618/35.

REFINING HYDROCARBON MIXTURES, process.—Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. Aug. 17, 1934. 21534/35.

NITROGENOUS CELLULOSE COMPOUNDS, manufacture.—I. G. Farbenindustrie. Aug. 14, 1934. 21734/35.

HIGH-PRESSURE AND HIGH-TEMPERATURE LPBRICANTS and methods of lubrication.—Sulflo Corporation of America. Aug. 15, 1934. 21977/35.

SUSPENSIONS FOR LUBRICATION and other purposes.—Sulflo Corporation of America. Aug. 15, 1934. 21978/35.

ASPHALTIC MATERIAL and process for producing the same.—Standard Oil Co. of California. Aug. 11, 1934. 22090/35.

MATERIALS FOR COMBATING PESTS.—Soc. of Chemical Industry in Basle. Aug. 14, 1934. 22415/35.

COLOURED MASSES, manufacture.—Soc. of Chemical Industry in Basle. Aug. 13, 1934. 22677/35.

HIGHLY CONCENTRATED NITRIC ACID, manufacture.—Hydro Nitro Soc. Anon., and T. Hobler. Aug. 13, 1934. 22805/35.

JOINING OF INORGANIC AND METALLIC ELEMENTS.—Porzellanfabrik Kahla and H. Handrek. Aug. 13, 1934. 22830/35.

BAKED CEREAL PRODUCTS, production.—E. I. du Pont de Nemours and Co. Aug. 14, 1934. 22894/35.

CALCIUM CYANAMIDE, manufacture.—Akt.-Ges. für Stickstoffdünger. Aug. 14, 1934. 22910/35.

WASHING AND CLEANSING.—I. G. Farbenindustrie. Aug. 14, 1934. 22911/35.

AZO DYESTUFFS, manufacture and production.—I. G. Farbenindustrie. Aug. 16, 1934. 22987/35.

VAT DYESTUFFS, process for manufacture.—I. G. Farbenindustrie. Aug. 16, 1934. 23070/35.

CELLULOSE ESTERS, production.—E. I. du Pont de Nemours and Co. Aug. 16, 1934. 23101/35.

ACETYLATED ALKYLTRIMETHYLOLMETHANES and the use thereof, production.—Bombrini Parodi-Delfino. Aug. 17, 1934. 23186/35.

Specifications Accepted with Date of Application

KNOCK-STABLE MOTOR FUELS by destructive hydrogenation of liquid hydrocarbons, production.—H. E. Potts (International Hydrogenation Patents Co., Ltd.). Oct. 11, 1934. 442,385.

PRECIPITATION OF GOLD or other metals from metallurgical cyanide solutions.—Merrill Co. Dec. 27, 1933. 442,315.

PREGNANOLONES, production.—Schering-Kahlbaum A.-G. Dec. 23, 1933. 442,319.

AQUEOUS EMULSIONS, preparation.—H. T. Böhme A.-G. March 16, 1934. 442,466.

DI-CALCIUM PHOSPHATE or of mixed fertilisers containing the same, production.—Kali-Forschungs-Anstalt Ges. Feb. 14, 1934. 442,395.

INDIGOID VAT DYESTUFFS, manufacture.—I. G. Farbenindustrie. Feb. 10, 1934. 442,185.

HETEROCYCLIC COMPOUNDS, process for manufacture.—Schering-Kahlbaum A.-G. April 17, 1934. 442,190.

BLEACHING WOOD PULP, processes.—A. Danninger. April 18, 1935. 442,336.

COPPER-CONTAINING CELLULOSE SOLUTIONS with employment of dilute aqueous ammonia, process for preparing.—W. Traube. July 23, 1935. 442,357.

SULPHURIC ESTERS OF HIGHER MOLECULAR ALCOHOLS, preparation. Chemical Works, formerly Sandoz. July 27, 1934. 442,198.

WATER-SOLUBLE COLLOIDAL MOLYBDENUM, method of producing. P. R. Vessie. Aug. 2, 1935. 442,410.

SULPHATES OF BARIUM AND CALCIUM, production.—Titan Co., Inc. Sept. 27, 1934. 442,360.

AZO DYESTUFFS, process for manufacture.—A. Carpmael (I. G. Farbenindustrie. Aug. 2, 1934. 442,672.

SPLITTING OF HYDROCARBONS of high boiling point into those of lower boiling point.—Coutts & Co., and F. Johnson (legal representatives of J. Y. Johnson (deceased)). (I. G. Farbenindustrie). Aug. 7, 1934. 442,592.

ORGANIC VINYL SULPHOXIDES and vinyl sulphones, manufacture and production.—Coutts and Co. and F. Johnson (legal representatives of J. Y. Johnson (deceased)). (I. G. Farbenindustrie.) Aug. 8, 1934. 442,524.

ORGANIC SULPHUR COMPOUNDS, manufacture and production.—Coutts and Co. and F. Johnson (legal representatives of J. Y. Johnson (deceased)). (I. G. Farbenindustrie.) Aug. 8, 1934. 442,525.

ALKALI METAL CYANIDES, manufacture.—E. I. du Pont de Nemours and Co. Aug. 8, 1933. 442,528.

NAPHTHALENE DERIVATIVES, manufacture.—Imperial Chemical Industries, Ltd., M. Wyler and A. Kershaw. Aug. 8, 1934. 442,529.

SAFETY PAPER, preparation.—Imperial Chemical Industries, Ltd., C. Paine and J. A. Radley. Aug. 8, 1934. 442,530.

Applications for Patents

(February 6 to 12 inclusive.)

1 : 1-DICHLORETHANE, preparation.—Consortium für Elektrochemie Industrie Ges. (Germany, Feb. 22, '35.) 4122.

POLYMERISATION PROCESSES.—A. Davies and W. G. Dewsbury. 4296.

AMMONIUM SALTS, process for making.—F. B. Dehn (Pennsylvania Salt Manufacturing Co.). 4144.

HYDRAULIC CEMENT.—Dewey and Almy, Ltd. (Dewey and Almy Chemical Co.). 4280.

DISPERSING, ETC., AGENTS.—E. I. du Pont de Nemours and Co. 3636.

AZO DYESTUFFS, manufacture.—W. W. Groves (J. R. Geigy). 4010, 4011.

3-HYDROXY-DIPHENYLENE OXIDE and substitution products, manufacture.—W. W. Groves (J. R. Geigy). 3904.

EXTRACTION OF HORMONES, process.—N. Heilpern. 3986.

VINYL COMPOUNDS, manufacture.—I. G. Farbenindustrie. 3782, 3783.

PURIFYING FEEDWATER FOR BOILERS, method.—I. G. Farbenindustrie. (Germany, Feb. 7, '35.) 3793.

PACKAGES OF CHEMICALS.—I. G. Farbenindustrie. (United States, Feb. 8, '35.) 4012.

AZO DYESTUFFS, manufacture.—I. G. Farbenindustrie. (Germany, July 20, '35.) 4249.

CHLORINATED RUBBER, manufacture.—Imperial Chemical Industries, Ltd. 4182.

ALKALI METAL HYDROXIDES, manufacture.—Imperial Chemical Industries, Ltd., and J. L. Clifford. 4183.

RUBBER ARTICLES, manufacture.—Imperial Chemical Industries, Ltd. 4185.

QUATERNARY AMMONIUM SALTS.—Imperial Chemical Industries, Ltd., H. A. Piggott and C. S. Woolvin. 4302.

AZO DYESTUFFS.—Imperial Chemical Industries, Ltd., N. H. Haddock and C. H. Lumsden. (June 28, '34.) 4303.

VINYL COMPOUNDS, manufacture.—G. W. Johnson. 3782, 3783.

CONDENSATION PRODUCTS, manufacture.—G. W. Johnson (I. G. Farbenindustrie). 3639.

LUBRICATING OILS, manufacture.—G. W. Johnson (I. G. Farbenindustrie). 3784.

POLYNUCLEAR COMPOUNDS, recovery.—G. W. Johnson (I. G. Farbenindustrie). 3785.

DYESTUFFS, manufacture.—G. W. Johnson (I. G. Farbenindustrie). 3786.

MEANS FOR RECOVERING ORGANIC PRODUCTS from solid carbonaceous substances by pressure extraction.—G. W. Johnson (I. G. Farbenindustrie). 3897.

UNSATURATED CARBONS, production.—G. W. Johnson (I. G. Farbenindustrie). 3898.

WATER-SOLUBLE CONDENSATION PRODUCTS, production.—G. W. Johnson (I. G. Farbenindustrie). 3899.

BASIC DYESTUFFS of the triphenylmethane series, manufacture.—G. W. Johnson (I. G. Farbenindustrie). 3974.

OXYGEN-CONTAINING COMPOUNDS OF CERIUM, preparation.—Soc. de Produits Chimiques des Terres Rares. (France, Feb. 8, '35.) 4057.

LUBRICANTS AND OTHER HYDROCARBON PRODUCTS.—Standard Oil Development Co. (United States, June 6, '35.) 3941.

(February 13 to 19 inclusive.)

DYEING, process.—Aceta Ges. (Germany, Feb. 21, '35.) 4912.

SEPARATING IRON OXIDES FROM ORES containing them, method.—E. Attali and R. d'Autheville. 4546.

ORGANIC SUBSTANCES, manufacture.—S. C. Bate, British Celanese, Ltd., and H. Dreyfus. 4979.

VULCANISATION OF RUBBER.—Belvedere Chemical Co., Ltd. (United States, Feb. 16, '35.) 4778.

ANTHRAPYIDAZINES, manufacture.—A. G. Bloxam (Soc. of Chemical Industry in Basle). 4374.

VAT DYESTUFFS, manufacture.—A. G. Bloxam (Soc. of Chemical Industry in Basle). 4375, 4534.

DYESTUFFS AND INTERMEDIATE PRODUCTS, manufacture.—A. G. Bloxam (Soc. of Chemical Industry in Basle). 4535.

FERROUS COMPOUNDS, manufacture.—A. G. Bloxam (Soc. of Chemical Industry in Basle). 4911.

TETRAKIS-AZO-DYESTUFFS, manufacture.—A. Carpmael (I. G. Farbenindustrie). 4404.

CONDENSATION PRODUCTS, manufacture.—A. Carpmael (I. G. Farbenindustrie). 4408.

PHTHALOCYANINES, manufacture.—A. Carpmael (I. G. Farbenindustrie). 4581.

VALUABLE PRODUCTS from β-halogenketones, manufacture.—A. Carpmael (I. G. Farbenindustrie). 4688.

FORMAMIDE, manufacture.—E. I. du Pont de Nemours and Co. and A. T. Larson. 4382.

CLEANING INTERIORS OF ENCLOSED SPACES by volatile grease solvents.—E. I. du Pont de Nemours and Co. (United tSates, March 18, '35.) 4569.

STABILISATION OF ANIMAL ETC., FATS, ETC.—E. I. du Pont de Nemours and Co. (United States, Feb. 15, '35.) 4837.

POLYMERISED ESTERS of methacrylic acid, etc.—E. I. du Pont de Nemours and Co. (United States, Feb. 19, '35.) 4956.

ESTERS OF THE THIO-ACIDS of phosphorus, manufacture.—E. I. du Pont de Nemours and Co. (United States, Feb. 19, '35.) 5088.

ALKYL SYNTHETIC RESINS, production.—C. S. Farmer. 4424, 4425.

SECONDARY ALCOHOLS of the cyclopentanohydrophenanthrene series, manufacture.—W. W. Groves (Soc. of Chemical Industry in Basle). 5042.

POWDER METALLURGY.—Hardy Metallurgical Co. (United States, Sept. 24, '35.) 4553.

PY-3-OXYTETRAHYDRO-OXYNAPHTHOQUINOLINES, manufacture.—I. G. Farbenindustrie. (Germany, Feb. 20, '35.) 4376.

UREAS FROM ALPHA-OMEGA-DIAMINOCARBOXYLIC ACIDS, production.—I. G. Farbenindustrie and G. W. Johnson. 4384.

VAT DYESTUFFS, production.—I. G. Farbenindustrie and G. W. Johnson. 5045.

MEANS FOR RECOVERING SULPHUR DIOXIDE from gas mixtures.—Imperial Chemical Industries, Ltd. 4380.

VULCANISATION ACCELERATORS.—Imperial Chemical Industries, Ltd. 4381, 5087.

ACID GASES, treatment.—Imperial Chemical Industries, Ltd. 4567.

DETONATORS.—Imperial Chemical Industries, Ltd. 4568.

AN OIL OF HIGH BOILING POINT suitable as a heating oil or motor fuel, manufacture.—G. W. Johnson (I. G. Farbenindustrie). 4514.

PHOSPHORIC ACID, manufacture.—G. W. Johnson (I. G. Farbenindustrie). 4797.

REMOVAL OF ORGANICALLY-COMBINED SULPHUR from gases.—G. W. Johnson (I. G. Farbenindustrie). 4920.

ETHYL CHLORIDE, production.—G. W. Johnson (I. G. Farbenindustrie). 4921.

AROMATIC HYDROCARBON COMPOUNDS of low boiling point, production.—G. W. Johnson (I. G. Farbenindustrie). 4922.

CALCIUM NITRATE IN SOLID FORM, production.—G. W. Johnson (I. G. Farbenindustrie). 5043.

PIGMENTAL COLOURING MATTER, production.—W. Mühlberg. (Germany, Feb. 19, '35.) 4364.

ACETIC ACID, production.—M. Williams. 4699.

Weekly Prices of British Chemical Products

WITH the exception of the products mentioned below, the prices of British chemicals remain as reported in THE CHEMICAL AGE last week (pages 202-203).

LONDON.—There has been a moderate volume of inquiry received during the past week. Prices continue steady and show little alteration.

MANCHESTER.—The outlook in respect of business in chemical products in the Manchester district is reasonably bright and the atmosphere of the market during the past week has been cheerful. A moderate volume of fresh spot and early delivery bookings has been reported, but with the principal consumers already well booked new contract buying is necessarily small. However, sellers have little of which to complain as regards the quantities covered by current delivery specifications, and the position in this respect is regarded as satisfactory. Textile chemicals are being taken up fairly well and in most other directions regular deliveries are being called for. The price position is markedly steady and the feeling is that any changes over the next few months will be upward. In the by-products market trading is on a moderate scale and the light sections, in particular, are maintained.

SCOTLAND.—Business in chemicals has again been rather quiet during the week both for home trade and export. Prices, however, continue quite steady at about previous figures with no outstanding changes to report.

Coal Tar Products

NAPHTHALENE.—Crude, whizzed or hot pressed, £17 10s. per ton; purified crystals, £22 to £23 per ton in 2-cwt. bags. LONDON: Fire lighter quality, £3 to £3 10s.; 74/76 quality, £4 to £4 10s.; 76/78 quality, £5 10s. to £6. SCOTLAND: 40s. to 50s.; whizzed, 70s. to 75s.

PITCH.—Medium, soft, 42s. 6d. to 43s. per ton, in bulk at makers' works. MANCHESTER: 40s. f.o.b., East Coast.

General Chemicals

SODIUM SULPHATE (SALT CAKE).—Unground spot, £3 12s. 6d. per ton d/d station in bulk. SCOTLAND: Ground quality, £3 5s. per ton d/d. MANCHESTER: £3 2s. 6d. to £3 5s.

SULPHATE OF COPPER.—MANCHESTER: £14 17s. 6d. per ton f.o.b.

Pharmaceutical and Photographic Chemicals

METHYL SALICYLATE.—1s. 2½d. to 1s. 3½d. per lb.

Nitrogen Fertilisers

SULPHATE OF AMMONIA.—£7 5s. per ton for neutral quality basis 20.6% nitrogen delivered in 6-ton lots to farmer's nearest station.

CALCIUM CYANAMIDE.—March, £7 3s. 9d. per ton; April/June, £7 5s., delivered in 4-ton lots.

NITRO-CHALK.—£7 5s. per ton delivered in 6-ton lots to farmer's nearest station.

NITRATE OF SODA.—£7 12s. 6d. per ton delivered in 6-ton lots to farmer's nearest station.

CONCENTRATED COMPLETE FERTILISERS.—£10 10s. to £10 19s. per ton according to analysis, delivered in 6-ton lots to farmer's nearest station.

AMMONIUM PHOSPHATE (N.P.) FERTILISERS.—£10 5s. to £13 15s. per ton according to analysis, delivered in 6-ton lots to farmer's nearest station.

Forthcoming Events

LONDON

Mar. 9.—Institution of the Rubber Industry (London Section). "Press Moulding of Vulcanised Rubber." Fordyce Jones. 7.45 p.m. 12 St. James's Square, London.

Mar. 10.—The Pharmaceutical Society of Gt. Britain. Conversazione. 7 to 10 p.m. 17 Bloomsbury Square, London.

Mar. 11.—Institute of Metals. Annual general meeting. 10 a.m. Hall of the Institution of Mechanical Engineers, Storey's Gate, London. Annual dinner and dance. 7 p.m. Trocadero Restaurant, Piccadilly Circus, London.

Mar. 11.—Institute of Fuel. "The Formation of Coal with particular reference to its behaviour under Heat and Pressure." Dr. Elvet Lewis. 6 p.m. Burlington House, Piccadilly, London.

Mar. 12.—The Institute of Vitreous Enamellers. "Modern Vitreous Enamelling Practice in America." I. N. Whitesmith. 8 p.m. British Industries House, Marble Arch, London.

BIRMINGHAM

Mar. 13.—Chemical Engineering Group and Birmingham Section of the Society of Chemical Industry. "Boiler Water Conditioning." C. W. Tod. 7.30 p.m. The University, Edmund Street, Birmingham.

BRADFORD

Mar. 12.—Society of Dyers and Colourists (West Riding Section). "Application of Metal Spraying for the Dyeing and Textile Industries—Modern Methods of Reducing Maintenance Costs and Increasing Efficiency." Noel H. Kitchen. Bradford.

CARDIFF

Mar. 9.—University College. "Artificial Radioactivity." Professor S. Sugden. 5.30 p.m. University College, Cardiff.

Mar. 11.—Society of Chemical Industry (South Wales Section). "Recent Advances in Food Chemistry." Dr. H. E. Cox. 7.30 p.m. Technical College, Cardiff.

GLASGOW

Mar. 9.—Institute of Metals (Scottish Section). "The Centrifugal Casting of Non-Ferrous Metals." Francis W. Rowe. 7.30 p.m. 39 Elmbank Crescent, Glasgow.

LEEDS

Mar. 9.—Society of Chemical Industry (Yorkshire Section). "Chemical Standards." Dr. E. F. Armstrong. 7.30 p.m. University, Leeds.

LIVERPOOL

Mar. 12.—Institute of Chemistry (Liverpool Section). "Food Legislation." H. E. Monk. 7.30 p.m. Constitutional Club, India Buildings, Water Street, Liverpool.

MANCHESTER

Mar. 12.—The Chemical Society. Original Papers. 7 p.m. University, Manchester.

NEWCASTLE-ON-TYNE.

Mar. 13.—Society of Chemical Industry (Newcastle-on-Tyne Section). Annual meeting. 7.30 p.m. Armstrong College, Newcastle-on-Tyne.

SHEFFIELD

Mar. 13.—The Chemical Society. "Carbohydrates." Professor W. N. Haworth. 5.30 p.m. University, Sheffield.

Mar. 13.—Institute of Metals (Sheffield Section). Annual general meeting. 7.30 p.m. University, Sheffield.

STOKE-ON-TRENT

Mar. 9.—The Ceramic Society. Question Box Evening. 7.30 p.m. North Staffordshire Technical College, Stoke-on-Trent.

WIDNES

Mar. 12.—British Association of Chemists (Liverpool Section). 7.30 p.m. Central Hotel, Widnes.

WORKINGTON

Mar. 14.—The West Cumberland Society of Chemists and Engineers. "Open Hearth Practice." R. P. Smith. 7 p.m. Workington.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

South Africa.—The British Trade Commissioner at Johannesburg reports that the South African Railways and Harbours Administration is calling for tenders, to be presented in Johannesburg by April 6, 1936, for the supply of high-pressure steam jointing for the period July 1, 1936, to June 30, 1937. (Ref. T.Y. 5743.)

Argentina.—The Commercial Counsellor to H.M. Embassy at Buenos Aires reports that the Argentine State Oilfields Directorate is calling for tenders, to be presented in Buenos Aires by March 24, 1936, for the supply of molybdenised chromium steel tubes, seamless steel boiler tubes and naval brass tubes. (Ref. T.Y. 5744.)

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

(NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt as specified in the last available Annual Summary, is also given marked with an *—followed by the date of the Summary, but such total may have been reduced.)

MANCHESTER CELLULOSE FINISHES, LTD. (M., 7/3/36.) Registered February 24, £1,686 16s. 8d. and further advances mortage to Leeds Provincial Building Society; charged on land and buildings in Chester Road, Stretford; also registered February 24, mortgage to National Bank, Ltd., securing all moneys due or to become due to the Bank; charged as above and subject thereto with plant, etc.; also registered February 24, £450 debentures; general charge, subject to above mortgages.

SCOLITE, LTD., Welwyn Garden City, manufacturers of synthetic resin products. (M., 7/3/36.) Registered February 21, £300, £500, £400 and £500 debentures, part of £5,000 already registered. *£8,500. February 5, 1934.

Satisfaction

MANCHESTER CELLULOSE FINISHES, LTD. (old company). (M.S., 7/3/36.) Satisfactions registered February 24, of mortgages registered November 4, 1929, and February 21, 1931, and of two debentures registered December 22, 1931.

County Court Judgments

(NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court Judgments against him.)

CONWAY, N. (male), 55 Mexborough Grove, Leeds, analytical chemist. (C.C., 7/3/36.) £10 1s. 0d. January 31.

New Companies Registered

Belmont Coal-Oil Co., Ltd., 1 Newgate Street, Newcastle-on-Tyne.—Registered as a "public" company on February 28. Nominal capital £45,000. To adopt an agreement with Coal-Oil Development (Gt. Britain), Ltd., for the purchase of (1) the properties, plant, equipment, rights and powers of the Grange Colliery at Belmont, Co. Durham; and (2) a licence to treat coal, cannel, shale, tobanite or other hydrocarbon material by the "Freeman" patent transformation process the subject of letters patent of the U.K., to produce, treat, refine, deal in and to stores in bond or otherwise, petroleum and petroleum products and all forms of oil to be derived from coal, cannel, shale, torbanite or other hydrocarbon material, to erect plants and to provide and manufacture machinery for these purposes, etc. Directors: William Keag, Hon. Joseph Pease, J.P., Frank B. Spencer, Derrick L. Crimp, Henry P. Hoyle.

Bideford Black Pigments, Ltd., 25 Wetherby Mansions, Earls Court Square, S.W.5.—Registered February 6. Nominal capital £100. To search for and dispose of mineral black, carbon, coal, anthracite, oil, iron, chemical substances, mineral dyes, clay, precious and other metals, minerals and other substances, and to carry on the business of colliery proprietors, mine owners, etc. A subscriber: H. St. L. Cookes.

Gallowhur Chemicals, Ltd.—Registered February 17. Nominal capital £7,000. To acquire and hold shares, stocks, debentures, debenture stock, bonds, obligations and securities; to carry on the business of chemists, druggists, drysalters, oil and colourmen, brewers' chemists, paint and colour grinders, manufacturers of and dealers in essences and essential oils, etc. Subscriber: Convers Surtees, 18 Austin Friars, London, E.C.

H. C. Process, Ltd., Stone House, Bishopsgate, E.C.2.—Registered February 6. Nominal capital £6,000. To acquire coal, cannel, shale, torbanite and oil-bearing lands and properties of all kinds, and to search for, mine, treat, distil and prepare such substances for the production of oil, spirit, chemicals and artificial fertilisers, smokeless fuels and bye-products, etc. A subscriber: Thos. W. Watson.

Company News

Associated Dyers and Cleaners.—A net loss is reported for 1935 of £27,707, against £34,164; deducting balance of general reserve of £2,124, leaves debit of £25,583 carried forward.

Staveley Coal and Iron Co.—An interim dividend of 3 per cent., tax free, is announced on the company's £3,385,356 of £1 shares. This is the same as a year ago. The total dividend for 1934-35 was 8 per cent., tax free, against 6½ per cent. in 1933-34.

United Turkey Red.—The net profit for 1935 was £3,253, to which is added amount brought in, £7,765. The directors recommend that dividend on first preference shares be paid on March 27, and charged against reserves. No dividend is to be paid on second preference or ordinary shares. Last year there was a loss, after maintenance and depreciation, of £10,830.

Monsanto Chemicals, Ltd.—A profit of £111,066 is reported for 1935, after providing for tax and depreciation. The company was registered in 1934 and for the initial half-year there was a profit of £42,000, after tax and depreciation. An amount of £10,000 is provided for extra depreciation and obsolescence reserve (making £39,018 in all for the year), and the balance of preliminary expenses, £8,081, is written off. After providing for preference dividends for 1935, £97,827 is carried forward, against £21,834.

Celanese Corporation of America.—The report for 1935 states that the net income transferred to surplus was $4,057,227, as compared with $3,229,459 for the previous year, an increase of $827,768. Dividends aggregating $1,840,979 were distributed to the holders of the 7 per cent. cumulative series prior preferred shares and the 7 per cent. cumulative first participating preferred shares. The participating dividend to which the holders of the 7 per cent. cumulative first participating preferred shares are entitled will be paid when declared by the board. Capital expenditures during the year approximated $3,000,000.

Evans Sons Lescher and Webb.—The trading profit for the past year was £53,836, against £45,112 in the previous year. To general reserve is placed £15,000, one and a half year's dividends on preference shares is £16,866, leaving to be carried forward £5,246.

Indestructible Paint Co.—A final dividend is announced for 1935 on the £1 ordinary shares of 13¾ per cent., making 20 per cent. for year, subject to tax, payable on April 30. A similar payment was made last year, compared with 15 per cent. for 1933.

North Broken Hill.—The payment is announced in Melbourne on March 27 of a dividend of 12½ per cent. and a bonus of 5 per cent. for the year to June 30, 1935. This makes a total of 52½ per cent. to date. For the whole of 1934-35 the dividend was 40 per cent.

Amalgamated Zinc (De Bavay's), Ltd.—The directors have declared a dividend at 2½ per cent. for the six months to December 31 last, payable on April 9. A similar final dividend was paid a year ago. The company has paid a total dividend of 5 per cent. for several years.

Canadian Industries.—This company which is associated with Imperial Chemical Industries, Ltd., has declared a dividend of 5 dollars 85 cents on the ordinary shares for 1935, after provision for prior charges, including preferred dividends. Gross earnings for 1935 amounted to $5,611,000, compared with $5,471,000 in 1934. Net earnings amounted to $4,299,000, against $4,663,750.

Shawinigan Water and Power.—The report for 1935 shows gross operating revenue $11,700,065, to which is added other revenue, $1,367,734, making $13,067,799; after deducting operating expenses and other expenses $5,407,076, and fixed charges $4,018,757, there remains net earnings $3,641,966, against $3,367,443. The sum of $1,000,000 is placed to depreciation, $100,000 to exchange equalisation account, dividends for year $1,132,690, leaving surplus $1,409,275. To this is added $1,832,027 from previous year, less amortisation of bond discount and expense $2,267,418, leaving surplus subject to 1935 taxes of $973,889.

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